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The Impact of Working Memory on Response Order Effects and Question Order Effects in Telephone and Web Surveys

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THE IMPACT OF WORKING MEMORY ON RESPONSE ORDER EFFECTS AND QUESTION ORDER EFFECTS IN TELEPHONE AND WEB SURVEYS

by

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It has been theorized that working memory plays a role in survey methodology contributing to response order and question order effects; however, there is little empirical evidence linking working memory and survey context effects. This dissertation examines whether respondents' working memory influences response order and question order effects through incorporating working memory measures into the survey questionnaire. The subjects were randomly assigned to complete the survey via telephone or web, and respondents completed a series of working memory measures and attitudinal questions.

It was hypothesized that as working memory capacity improved there would be a decrease in the likelihood of respondents of all ages selecting the options associated with response order effects. Results support the hypothesis for younger adults who became less susceptible to response order effects as working memory improves, however, for older adults the results adversely indicate that improvement in working memory leads to respondents being more likely to select the early responses in web and late responses in telephone. The results are present for questions with a short list of two responses and for questions with a longer list of six responses.

Where question order effects are concerned, it was hypothesized that respondents with higher working memory would be more likely to be influenced by the preceding question than those with low working memory. In general the results provide only modest support that working memory has a significant impact on question order effects. In only one of three pairs of questions analyzed did working memory have a significant effect indicating that respondents with higher working memory are more likely to exhibit contrast effects than respondents with lower working memory.

As another objective, this dissertation included a subset of the Health and Retirement Study (HRS) cognitive measures into the survey to assess whether they adequately reflect respondents' working memory. Comparing the working memory and HRS measures, the results show significant differences between the measures indicating they reflect different underlying cognitive constructs. These findings indicate that the cognitive section of the HRS, and similar studies, may benefit from including measures designed specifically for working memory.

To Mom, Grandma, Granny, Papaw, & Aunt Ted.

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CHAPTER 1: INTRODUCTION

1.1 Introduction and Research Objectives

For the past few decades, researchers within the field of survey methodology have been studying the impact of cognitive processes on the quality and accuracy of survey responses under the cognitive aspects of survey methodology (CASM) movement (Jabine, Straf, Tanur, & Tourangeau 1984; Jobe & Mingay, 1991). The CASM movement started as a way of linking the research in cognitive psychology and survey methodology. For researchers in the field of survey methodology, integrating theories from cognitive psychology into their research helped to better understand and potentially minimize measurement or response errors (Belli, 2005; Tourangeau, 2003). *Psychology of Survey Response* (Tourangeau, Rips, & Rasinski, 2000) is an often referenced source in the field of survey methodology for the wealth of information it contains on research under the focus of CASM. Tourangeau (2003) summarized the material in the book as "reporting errors in surveys arise from problems in the underlying cognitive processes through which respondents generate their answers to survey questions" (p. 5). When answering a survey question, respondents engage in cognitive processes including seeking an understanding of the meaning of the question, retrieving information relevant to answering the question, making a judgment based on the retrieved information, and mapping the judgment to an appropriate response (Tourangeau et al., 2000).

Under the umbrella of CASM, researchers have specifically studied the impact of respondents' memory on their ability to answer questions. This memory research has largely focused on examining 1) how autobiographical memory, the memory of one's own past experiences, impacts the ability to recall past events and retrospectively answer

behavioral questions (Belli, 2013; Blair & Burton, 1987; Friedman, 1993), and 2) whether attitudes are well-established and stored in memory or constructed at the time the response is made (Eagly & Chaiken, 1993; Schwarz & Bohner, 2001; Tourangeau, 1992). Both of these areas of memory research focus on specific aspects and influences of memory in survey methodology; however, to date, there has been little research that has specifically examined how respondents' working memory affects their responses. One exception has been the work of Knäuper and colleagues (Knäuper, 1999; Knäuper, Belli, Hill, & Herzog, 1997; Knäuper, Schwarz, Park, & Fritsch, 2007; Knäuper, & Wittchen, 1994) who examined the impact of working memory on survey responding.

The purpose of my dissertation research is to build upon and extend the previous research of Knäuper and colleagues by gaining a more complete understanding of the role of working memory in survey research, particularly with the answering of attitude questions. Through collecting and analyzing new data, my research will address four research questions. Does working memory impact question order and response order effects? Is the impact of working memory on question order and response order effects consistent across two modes of survey administration, telephone and web? Is the impact of working memory on question order and response order effects consistent across all ages? How do working memory measures compare to memory measures from the Health and Retirement Study (HRS)?

1.2 Psychological Research on Working Memory

1.2.1 Defining Working Memory

Working memory is a system that involves the limited storage of relevant information and transient processing needed to perform an ongoing cognitive task

(Baddeley & Hitch, 1974). Gathercole and Baddeley (1993) discuss the working memory model as comprised of three parts: the central executive, the visuo-spatial sketchpad, and the phonological loop. In this model, the central executive functions similar to a control panel by impacting how one reacts to the incoming information through sorting the information into one of the other two components (visuo-spatial sketchpad or phonological loop), retrieving information from long-term memory, and allocating attention. The phonological loop processes incoming verbal information while the visuo-spatial sketchpad processes visual and spatial information. The more familiar one is with the incoming information, the more automatic the processing of the information becomes, and the burden on the central executive is decreased (Gathercole & Baddeley, 1993).

Just and Carpenter (1992) theorized that working memory is comprised of a pool of shared resources used for both temporary storage and active processing. Expanding upon the role of the central executive, Just and Carpenter (1992) proposed the capacity constrained comprehension theory. Their theory considers capacity limitations in working memory for the storage and processing of information, believing that both storage and processing utilize the same activation-based pool of resources. In this theory, working memory storage and processing are linked aspects of activation, and the activation needed between the two functions must stay below some maximum capacity for optimal performance. If activation exceeds an individual's capacity, then storage, processing, or both will begin to break down. For instance, when the maximum capacity is exceeded, some information that is needed may be forgotten and/or processing may decline. Thus, as activation resources are used to handle the demands placed on either of

the components, storage or processing, there are fewer resources available for the other component (Just & Carpenter, 1992).

Tasks involving working memory require that information is maintained in a temporary memory storage while simultaneous processing occurs requiring attention (Conway, Cowan, Bunting, Therriault, & Minkoff, 2002). The aspect of attention and simultaneous processing, in conjunction with a storage component, is what distinguishes working memory from short-term memory, which is now considered to be primarily a temporary storage only (Conway et. al, 2002; Engle, Tuholski, Laughlin, & Conway, 1999; Gathercole & Baddeley, 1993). In 1999, Engle et al. used a latent variable approach to provide support for Cowan's (1988, 1995) earlier research that suggested the respective existences of working memory and short-term memory, which although are unquestionably related, are also separate latent variable constructs that fall under a more general cognitive functioning construct. In their study, working memory was measured by tasks requiring the respondents to engage in both processing and storage where "attention must be shifted back and forth between the representation of the list items and the so-called processing component of the task" (Engle et al., 1999, p.314). One such task required participants to read a sentence followed by a random capitalized word, and they were instructed to remember the random word after each sentence. Following a series of sentences and random words, the participants were asked to recall the random words and answer a question that pertained to one of the sentences in the series. The requirements of this task and other similar tasks ensured that participants were engaging in storing words for later recall as well as actively processing additional information. In contrast, the tasks used for short-term memory required only the storage and recall of a

list of words. Engle et al. (1999) concluded, in agreement with Baddeley (1996) and Cowan (1995), that short term memory and working memory are related but separate constructs. Furthermore, these researchers support the Baddeley and Hitch (1974) theory of working memory focusing on the central executive as a vital component which is activated by attention, with attention being described as the "gatekeeper" for working memory (Awh, Vogel, & Oh, 2006, p. 202).

1.2.2 Working Memory Measures

Early researchers assumed individual differences in working memory capacity existed and theorized that working memory has a significant impact on reading comprehension. However, the memory measures that had previously been utilized focused on storage only and did not specifically measure working memory capacity, resulting in the need for new measures to evaluate working memory (Daneman & Carpenter, 1980). Over the years, many different working memory measures have been developed and implemented by researchers in an attempt to assess working memory capacity by engaging participants in both the processing and storing of information. Two of earliest, most widely cited and commonly used working memory measures are the reading span and listening span tasks (Daneman & Carpenter, 1980), also referred to as sentence span tasks. These measures can vary slightly, but they follow a typical format where participants are required to read or listen to a sentence, answer whether the sentence is true or false, then recall the final word of each sentence at the end of a set of sentences. Freitas, Ribeiro, Radanovic, and Mansur, (2007) provided examples of the phrases they used in their listening span measure. A few of their examples (translated from Portuguese) include: "Sugar is sweet", "Carrots can dance", "Fish swim in water",

and “Babies can drive”. Like the measure used by Engle et al. (1999), described earlier, some sentences are followed by an unrelated word, and the unrelated words are the ones to be remembered. Similar to the sentence span, the sentence digit span task also requires participants to indicate whether a sentence is true, but rather than remembering the final word of the sentence, each sentence is followed by a numerical value to be recalled at the end of the set of sentences (Turner & Engle, 1989). In the alphabet span task, participants are presented a series of words that they must repeat back after arranging them in alphabetical order (Craik, 1986; Waters & Caplan, 2003). For the subtract 2 span, participants receive a set of single digit numbers that they must repeat back after subtracting 2 from each digit (Salthouse 1988; Waters & Caplan, 2003). The operation span task is a measure that requires participants to verify whether a mathematical equation is correct while also remembering either a word or digit that follows the equation (La Pointe & Engle, 1990; Turner & Engle, 1989). The equations included either multiplication or division and addition or subtraction, for example “Is (8 x 1) + 8 = 16?” Similarly, in their computation span task, Salthouse & Babcock (1991) asked participants to listen to an addition or subtraction problem, select the correct response from three choices, and after a set of problems recall the last digit of each problem.

Under primary investigator Randal Engle, the Attention and Working Memory Lab at Georgia Institute of Technology has developed automated complex span tasks for measuring working memory capacity, located on their website http://englelab.gatech.edu. Their measures include an operation span (described earlier), symmetry span, and rotation span (Foster et al., 2015). In the symmetry span, participants determine if a shape is symmetrical along the vertical axis, next they are presented a 4x4 grid with a

pattern of red squares to remember. At the end of a set of shapes and grids the participants are tasked with recalling the red square location in the order in which they appeared in the set. For the rotation span, participants determine if a rotated letter is presented as a mirror image of itself, and the image is followed by an arrow to be remembered. The arrows were of different lengths pointing in different directions, and participants must recall each of the arrows after a set was presented.

With so many different working memory measures available it is difficult to know which ones are appropriate to use or how results of the tasks should be scored. Notable researchers in the field of working memory examined the reliability of several working memory measures (Conway et al., 2005; Waters & Caplan, 2003). Conway and colleagues (2005) reviewed the reading span, operation span, and counting span (a working memory measure typically used with children where they must count and recall the total number of shapes). The authors found each of these three measure to be both reliable and valid measures of working memory capacity. Similarly, Waters and Caplan (2003) examined the reliability and validity of several measures including the alphabet span, subtract 2 span, sentence span, running item span, and backward digit span. Their findings suggest that test-retest reliability is low when respondents are categorized into groups based on one measure. The test-retest reliability was much better when respondents were classified from a composite score of several measures. Combining the alphabet, subtract 2, and sentence spans, only 16% of respondents were classified differently from their two administrations, compared to over 30% for individual tasks. Thus, these findings point to the differences in how working memory measures can be scored and the implications these differences can have on analyses. Conway et al. (2005)

discuss different scoring approaches such as whether to score both the processing and recall aspects of the working memory tasks, determining if scores are assigned at the span level (all items must be correct) or at the item level (each item within a span is scored separately), and if longer length spans should be weighted higher than shorter spans. The measures described in this section are not an exhaustive list of those that have been used to measure working memory capacity, but these measures and others like them have been developed over the years to ensure participants engage both the processing and storage components of their working memory.

1.2.3 Working Memory, Fluid Intelligence, and Language Comprehension

Many researchers have examined the relationship between working memory and general fluid intelligence (Gf) (Ackerman, Beier, & Boyle, 2005; Conway et al., 2002; Engle, 1999; Kyllonen & Christal, 1990; Mogle, Lovett, Stawski, & Sliwinski, 2008; Salthouse & Pink, 2008; Unsworth & Engle, 2006), which includes logical reasoning, abstract thinking, and the ability to draw inferences and see relationships (Horn, 1982). Ackerman et al. (2005) discuss that while some researchers have alleged working memory and Gf to be the same constructs, results from their meta-analysis showed that the two are indeed separate constructs, although highly related. Engle et al. (1999) suggest that the central executive is the driving force behind the strong relationship between working memory and Gf. This suggestion is similar to the conclusion by Conway et al. (2002) that it may be the demands placed on active maintenance and attention that contribute the most to the relationship between working memory and Gf.

Conway et al. (2002) examined the effects of working memory, short-term memory, and processing speed on general fluid intelligence, and their results indicate

there is a significant positive relationship between working memory and Gf while neither short-term memory nor processing speed were significantly related to Gf. Their findings, in part, confirmed results from Engle et al. (1999) which determined that there is a direct significant relationship between Gf and working memory but not a significant relationship between Gf and short-term memory. Further evidence to support separate constructs comes from research showing that training on working memory tasks does not improve performance on intelligence tests (Chooi & Thompson, 2012; Colom et al., 2010; Melby-Lervåg & Hulme, 2013). For example, in one experiment, a group of participants trained for 20 days on working memory tasks and achieved a 44% improvement on those tasks, but there was no significant improvement on their pre- and post-test scores for intelligence measures (Chooi & Thompson, 2012). Taken together, this line of research points toward working memory and Gf as being related but separate latent variable constructs.

Working memory has also been shown to be related to language comprehension and language processing (Caplan & Waters, 1999; DeDe, Caplan, Kemtes, & Waters, 2004; Daneman & Merikle, 1996 Gathercole & Baddeley, 1993; Just & Carpenter, 1992). Speech requires a listener to continually process information in working memory (Marslen-Wilson & Tyler, 1980). Considering the working memory theory by Baddeley and Hitch (1974), language comprehension and processing engages both the central executive and phonological loop. Regardless of whether information is presented orally or visually, a greater level of processing is required as the difficulty of the incoming information increases (Gathercole & Baddeley, 1993). The increase in language processing needed for more difficult passages of information highlights individual

differences related to the working memory resources that people have available. As described earlier, the capacity constrained comprehension theory portrays working memory as an activation-based pool of resources, and for optimal working memory performance activation needs to remain under an individual's maximum capacity (Just & Carpenter, 1992). Relating this working memory theory specifically to language comprehension and processing, as more resources are allocated to processing there will be fewer resources available for storage. Easy passages do not require as much activation as do difficult passages, thus, easy passages tend to remain under the maximum capacity allowing a person to fully store and process the information (Just & Carpenter, 1992).

Complex sentence structure is an example of information that requires additional processing and increases the burden on working memory (Caplan & Waters, 1999; Just & Carpenter, 1992). Take the following sentence for example, "The defendant examined by the lawyer shocked the jury". Just and Carpenter (1992) discuss the complexity of this sentence which is a reduced relative clause. It is initially unclear who "examined", and participants needed additional processing to reach the interpretation that it was not the defendant who examined something but rather the lawyer who examined the defendant. Participants took longer to process the phrase "by the lawyer" in the first sentence than in the following relative clause sentence, "The defendant that was examined by the lawyer shocked the jury" (Caplan & Waters, 1999; Just & Carpenter, 1992). Another experiment examined the working memory of college students and how well participants could answer a question regarding a sentence immediately after hearing it (Roberts & Gibson, 2002). Using sentences with 3 clauses, the participants were asked for the subject or verb of one of the clauses. Roberts and Gibson (2002) found participants had more accuracy

in recalling the clauses they heard more recently, and working memory could account for a large portion of the sentence memory variance. The authors concluded that their results reinforced earlier similar findings that the clause is a significant storage unit in language processing (Blauberg & Braine, 1974) and the accuracy of recall is stronger for more recent clauses (Jarvella, 1971). The effects of working memory and language processing are important for survey researchers in designing questions that are easier for respondents to process, especially for respondents with lower working memory capacity.

1.2.4 Working Memory and Aging Effects

It is widely accepted that older adults have a decline in working memory capacity. Early studies on the aging effects of working memory are discussed by Carpenter, Miyake, and Just (1994) and Salthouse (1991). In 2005, Bopp and Verhaeghen conducted a meta-analysis assessing 123 studies from articles regarding memory span and aging. Of these 123 studies, 64 specifically contained working memory measures including reading span, listening span, and computation span. The meta-analysis compared younger adults, with a mean age of less than 30, to older adults, with a mean age greater than 60. In line with other research, results from the meta-analysis do indicate that there are age differences in working memory. A recent study found a significant negative correlation ($r = -.40$) between working memory and age (Caplan, DeDe, Waters, Michaud, & Tripodis, 2011). These results are similar to an earlier study which also obtained significant negative correlations between age and four separate working memory measures: alphabet span ($r = -.49$), subtract 2 span ($r = -.38$), simple reading span ($r = - .41$), and complex reading span ($r = -.39$) (Caplan & Waters, 2005).

It is likely that older adults have fewer working memory resources available, thus, the processing and storing of information can be more difficult for older adults as both components are vying for the same pool of resources (Norman & Bobrow, 1975; Morris, Gick, & Craik, 1988; Salthouse & Babcock, 1991; Brébion, Smith, & Ehrlich, 1997). This diminished capacity of working memory resources in older adults is reflected in the working memory differences among younger and older adults. Although, with easier tasks there is little to no effect on working memory for older adults (Just & Carpenter, 1992; Caplan et al., 2011), age differences in working memory are more prominent when task complexity is high (Gick, Craik, & Morris, 1988; Just & Carpenter, 1992; Babcock & Salthouse, 1990; Salthouse, 1991). For example, Gick et al. (1988) compared the working memory of younger ($\overline{x}$ age = 21.9 years, s = 2.0) and older adults ($\overline{x}$ age = 61.8 years, s = 4.8) in tasks that varied in their level of difficulty. Respondents' working memory capacity was measured using a sentence span where individuals were required to verify whether statements were true and remember the final word of each statement. Various statements were positively stated (e.g. "Cats usually like to hunt mice" or "A canary may often be bigger than a horse"), and to increase the complexity other statements were negatively stated (e.g. "Bookcases are not usually found by the sea" or "Children never like to play at the beach") (Gick et al., 1988, p.354). In addition, to further alter the complexity of the tasks there was a varying number of sentences in each set, such that an increase in the number of sentences increased the task complexity. Results of their study found a significant interaction between task complexity and age, thus, for more difficult tasks there was a stronger effect on the older respondents compared to the younger respondents (Gick et al., 1988). Similarly, researchers

conducting a later study using a listening span measure also concluded that the older adults in their study, with an average age of 66, lacked the working memory resources needed for processing higher difficulty tasks (Frietas et al., 2007).

Previous research has concluded that some of the aging effects on working memory can be attributed to a decline in processing speed in older adults (Caplan et al., 2011; Salthouse, 1994). Results from the Caplan et al. (2011) and Caplan & Waters (2005) studies indicate that age not only has a significant negative correlation with working memory but age also has a significan negative correlation with processing speed. Processing speed can impact working memory differences between younger and older adults on even simple tasks (Salthouse & Babcock, 1991), and older adults particularly struggle in processing information when it is presented at a fast pace (Stine, Wingfield, & Poon, 1986). One theory of decreased processing speed is that the processing speed of older adults may be impacted if the information that is needed was either not properly encoded or it is forgotten before it can be used, consequently slowing down processing (Salthouse, 1996; Bopp & Verhaeghen, 2005). It is also possible that processing speed deteriorates due to an overall reduction in the resources that older adults have available for both the storage and processing aspects of working memory, thus, older adults reach their maximum working memory capacity sooner making processing more difficult (Bopp & Verhaeghen, 2005; Morris, Gick, & Craik, 1988).

In addition to a decline in working memory resources and processing speed, there are other factors that may contribute to the aging effects we see on working memory capacity. Some of the aging effects that are present between younger and older adults could be attributed to differences in strategies utilized by the two groups. In a study by

Brébion et al., (1997), a group of younger adults ($\overline{x}$ age = 22.3 years, s = 2.1) and older adults ($\overline{x}$ age = 66.3 years, s = 5.2) were compared on how well they could remember an initial set of words after determining whether a follow up sentence was acceptable or inconsistent. The authors found that the groups employed different strategies on how to approach the tasks. The younger respondents most likely "tried to process the sentences and rehearse the words simultaneously" while the older respondents "seemed to give up on retaining the preload in order to pay attention to sentence processing" (Brébion et al., 1997, p.69). Accordingly, the different strategies used on this working memory task resulted in younger adults retaining more of the initial words while the older adults performed better on processing the sentences.

Researchers have also found that time of day may influence working memory performance and could contribute to aging effects. For example, older adults tend to be more alert in the morning while younger adults tend to be more alert in the evening (West, Murphy, Armilio, Craik, & Stuss, 2002). West et al. (2002) found that there were greater differences between younger and older adults when tasks were performed at a non-optimal time of day (e.g., morning for younger adults, evening for older adults).

Another contributing factor to aging effects may be the extent to which older adults are cognitively engaged on a daily basis. As an example, one study considered the impact of retirement. Using the HRS study, researchers examined performance on the Serial 7s task, and controlling for age to account for a natural decline in cognitive functioning, they found that the performance on the memory test had a significant negative correlation with having been retired for one year or longer (Bonsang, Adam, & Perelman, 2012). Although there is some debate on whether the Serial 7s is an

appropriate measure of working memory capacity (Herzog and Wallace, 1997), the results of this study do indicate that being retired may potentially play a role in the decline of working memory capacity in older adults (Bonsang et al., 2012).

1.3 An Overview of Effects in Survey Responding

1.3.1 Question Order Effects

In the field of survey methodology, two main context effects exist - question order effects and response order effects. Question order effects occur when the presence of a question impacts how a respondent formulates their response on a subsequent question, and these effects are often described as directional effects and split into two categories - consistency (or assimilation) and contrast (Schuman & Presser, 1981; Sudman Bradburn, & Schwarz, 1996; Tourangeau et al., 2000). Consistency or assimilation effects can occur when respondents include information retrieved for an earlier question to form their response on the later question, while contrast effects can occur when the information retrieved for an earlier question is excluded from the formation of the later response (Schuman & Presser, 1981; Sudman et al., 1996; Tourangeau et al., 2000). Classic examples of question order effects are presented by Schuman and Presser (1981) where they discuss question order effects across part-part questions and part-whole (or general-specific) questions. Part-part questions pertain to issues on a similar level in which the attitude objects of both questions fall under a more general category, versus part-whole questions in which the attitude object of one of the questions is more general in nature and one is more specific (Schuman & Presser, 1981). Examples of questions that have been used to show the existence of question order effects include asking respondents about general happiness and marital happiness (part-whole), overall interest in religion

and specific religious activities (part-whole), willingness to vote for a woman or Jew for President (part-part), and whether doctors and lawyers are interested in the public good (part-part) (Schuman & Presser, 1981; McFarland, 1981). Knäuper et al. (2007) found that working memory did impact question order effects in older adults. The results from their study found the presence of question order effects among the group of older respondents (aged 60 to 100) with high working memory capacity, but question order effects were not significant among older adults with low working memory capacity (Knäuper et al., 2007). These results supported the hypotheses that respondents with stronger working memory capacity are more influenced by information retrieved to answer the first question which is still retained in working memory upon answering the next question.

1.3.2 Response Order Effects

Response order effects occur when the order of response options impacts the selection of a response option (Schuman & Presser, 1981; Sudman et al., 1996). Response order effects are either revealed as primacy effects, where earlier items are selected more often, or recency effects, where later items are selected more often (Schuman & Presser, 1981; Sudman et al., 1996). Krosnick and Alwin (1987) theorized that whether primacy or recency effects will occur is due to the amount of cognitive processing extended to the response options. When items are presented visually respondents will spend more time on the items presented early, resulting in a primacy effect (Krosnick & Alwin, 1987). In contrast, when items are presented orally, the presentation of new items may interfere with the processing of the earlier items such that more attention is focused on the later items, resulting in recency effects (Krosnick &

Alwin, 1987). As one might expect, these response order effects have been found when there are several response options (Schwarz, Hippler, Noelle-Neumann, & Münkel, 1989). Somewhat surprisingly, they have also been shown to be present when there are only two response options, where primacy and recency effects still hold for questions presented visually and orally, respectively (Hippler, Schwarz, & Noelle-Neumann, 1989; McClendon, 1986). Response order effects have been shown to be more prominent among respondents with lower cognitive ability (Krosnick & Alwin, 1987). Knäuper (1999) determined that response order effects are more affected by age than education, and theorized that the age effects may be attributed to differences in working memory capacity. In general, older adults have fewer working memory resources available (Morris et al., 1988; Salthouse & Babcock, 1991), which may prevent older adults from retaining all of the response options, in turn resulting in more pronounced response order effects.

1.3.3 Survey Mode Effects

The mode of survey administration can impact how respondents cognitively proceed through answering survey questions (Schwarz, Strack, Hippler, & Bishop, 1991; Tourangeau et al., 2000). The most notable difference between interviewer-administered (e.g., telephone or in-person) and self-administered (e.g., web or mail) surveys is the sensory channels that are utilized by respondents, oral versus visual (Schwarz et al., 1991; Fricker, Galesic, Tourangeau, & Yan, 2005). Although there are many differences that can arise due to different modes of survey administration, the focus here will be on the differences in question order effects and response order effects.

Question order effects may differ across modes due to the presentation order of the questions being standardized in interviewer-administered surveys whereas in a self-administered survey respondents may choose to read (and answer) the questions "out of order" (Schwarz et al., 1991). Therefore, the context surrounding the presentation of a question may differ, which in turn would impact the information that is retrieved and easily accessible when answering a related question. Due to respondents having access to all the questions in a self-administered survey, Schwarz et al., (1991) discuss previous research that point toward weaker question order effects in self-administered surveys compared to interviewer-administered surveys. However, it is unclear how mail and web surveys, both self-administered, differ in regard to question order effects due to the differences in access respondents have to the questions. It may be more difficult for respondents to access questions out of order on web surveys if the respondents are required to load a separate page for each question rather than scrolling up and down for access.

The length of time spent on a survey may also contribute to question order effects. Time can vary across modes whereas interviewers tend to set a faster pace in interviewer-administered surveys due to avoiding the awkwardness of silence (Schwarz et al., 1991; Chang & Krosnick, 2009). Moving quickly from one question to the next, respondents may have an increased carry-over effect where information is maintained in their working memory storage as they begin processing the next question (Schwarz et al., 1991). This carry-over effect is likely to be diminished in a self-administered survey where respondents often proceed to the next question at a slower pace (Schwarz et al., 1991). Mode may also impact how long a respondent considers a question before providing a

response. If respondents feel rushed by an interviewer, they may spend less time on a subsequent question and may rely more heavily on information previously retrieved on an earlier question (Schwarz et al., 1991).

As noted earlier, surveys presented orally may lead to recency effects while surveys presented visually may lead to primacy effects. Similar to question order effects, response order effects may be attributed to the amount of time or attention spent on processing information (Krosnick & Alwin, 1987). When response options are presented orally by an interviewer they are not readily available for respondents to review, thus, respondents must maintain all of the options in their working memory. Respondents may not have enough time to fully process the earlier options before additional options are presented resulting in more attention on the later options leading to recency effects (Krosnick & Alwin, 1987; Schwarz et al., 1991). Although respondents can spend an equal amount of time on all of the response options presented in a visual mode, they often focus more on the earlier items resulting in primacy effects (Krosnick & Alwin, 1987; Schwarz et al., 1991). This focus on the earlier items may be attributed, in part, to the visual heuristic that "top means first" and the natural reading progression of top to bottom (Tourangeau, Couper, & Conrad, 2004). Eye-tracking technology has confirmed that respondents do indeed focus more attention on earlier response options and sometimes spend no time at all on the options at the end of the list (Galesic, Tourangeau, Couper, & Conrad, 2008).

1.4 Extending the Work of Knäuper and Colleagues

As noted above, in my dissertation I will extend the work of Knäuper and her colleagues. In exploring the impact of working memory on survey responses, working

memory differences have been found between high and low working memory capacity groups (Knäuper and Wittchen, 1994). Particularly among older respondents, question order effects were present for respondents with high working memory capacity but not for those with low working memory capacity (Knäuper et al., 2007). Another study theorized that the some of the age related response order effects present in older respondents may be attributed to the lower levels of working memory capacity in older respondents (Knäuper, 1999). Data quality was shown to be affected by cognitive ability, however due to the memory measures used from the Health and Retirement Study (HRS), the results may not be generalizable specifically to working memory effects (Knäuper et al., 1997). My dissertation will use this prior research as a guide for expanding the understanding of the role of working memory in survey research.

In 1994, Knäuper and Wittchen measured working memory to determine the effect it had on respondents who retrospectively reported any depressive symptoms over the course of their lifetime. Of the 63 respondents for this study, 31 were classified as older with an average age of 63.6 (range 55-75) and 32 were classified as younger with an average age of 31.5 (range 25-40). A sentence span was used to measure working memory capacity by having respondents indicate whether a statement was true or false and then recalling the final word of each statement. Examining the relationship between age and working memory, the results showed a significant negative relationship between the variables ($r=-.46$, $df=61$, $p<.0001$). The focus of the experiment was to determine if respondents with lower working memory capacity were more likely to attribute their depressive symptoms to physical ailments compared to respondents with higher working memory capacity. Respondents were first asked if they had ever experienced an array of

depressive symptoms, then for each symptom that had been experienced at any time during their life, the respondent was then asked if the symptoms were due to any physical factors such as illness or injury. To assign a cause for the depressive symptoms, respondents were required to answer a set of complex questions in which they needed to retain information retrieved concerning their retrospective report of depressive symptoms while forming a subjective judgment regarding the cause of the symptoms. Controlling for physical health, the results show that respondents with a low working memory capacity attributed their depressive symptoms to physical causes more often than those with high working memory capacity (Knäuper & Wittchen, 1994). Prior to including working memory into the model age was a significant predictor of attributing depressive symptoms to physical causes, however, the age effect became non-significant when the model included working memory. It is possible that the complexity of the assignment contributed to those with lower working memory capacity utilizing a cognitive shortcut, such as satisficing (Krosnick, 1991), for answering the follow up question. This experiment did find differences between low and high working memory capacity, although it is unclear if the findings on such complex questions, which include aspects of autobiographical memory in recalling personally dealing with depressive symptoms and their causes, are generalizable to simpler attitudinal questions. Thus, one aim of my dissertation is to extend the findings of Knäuper & Wittchen (1994) to questions that are less complex and focus solely on attitudes. My expectation is that there will also be working memory differences on questions of attitude as respondents with low working memory capacity may still encounter difficulty answering these types of questions.

Knäuper et al. (2007) examined question order effects by comparing three groups: younger respondents (aged 19 to 40), older respondents (aged 60 to 100) with low working memory capacity, and older respondents in the same age range with high working memory capacity. Working memory capacity was assessed using a reading span measure where respondents were presented short sentences, answered a question about the sentence, and recalled the last word of all of the sentences. For each group, Knäuper et al. (2007) examined responses on two pairs of attitude questions (also see Schuman & Presser, 1981), one set about abortion and one set about labor unions and working conditions, reversing the order of presentation within each pair on two versions of the questionnaire. Controlling for level of education, they found that question order effects were present for the younger group and the older respondents with high working memory capacity but not for the older respondents with low working memory capacity (Knäuper et al., 2007). This finding is consistent with their expectation, that question order effects should be attenuated in respondents with lower working memory capacity due to the first question not being as available in working memory during the second question. Their experiment shows that there are differences in question order effects among the older respondents according to their level of working memory. Their experiment, however, did not assess the impact of working memory on question order effects among the younger respondents. The comparison of high and low working memory groups within younger respondents will be addressed in my dissertation research, and as with the 2007 study, I expect to find differences in question order effects between older respondents with high working and older respondents with low working memory. In addition, question order effects are expected to vary between younger respondents with high working memory

younger respondents with low working memory. Since respondents will be presented only one question at a time in both administration modes, question order effects are predicted to be consistent across both the telephone and web surveys.

As noted earlier, research had indicated that there are age differences in working memory (Carpenter, Miyake, & Just, 1994; Salthouse & Babcock, 1991) with older adults having fewer working memory resources available (Morris, Gick, & Craik, 1988) as well as having a slower processing speed (Caplan et al., 2011; Salthouse, 1994) when compared to younger respondents. Therefore, in 1999, Knäuper used age as a proxy for working memory to indirectly assess the impact of working memory on response order effects. In her meta-analysis of response order effects, Knäuper (1999) found that response order effects were more prominent among older adults than younger adults. While working memory was not directly tested in this study, Knäuper theorized that some of the effects of age could be explained by differences in working memory capacity. Through using working memory measures across a wide range of ages, my study seeks to support Knäuper's conclusions of the impact of working memory on response order effects. It is assumed that respondents with low working memory capacity will be less able to retain some of the response options compared to those with high working memory capacity as respondents with low working memory will not be able to provide the same amount of attention to the response options. Therefore, in my dissertation I will examine whether a higher working memory aids respondents of all ages in being less susceptible to selecting the response options associated with primacy (web) and recency (telephone) effects. As mentioned earlier, recency effects are more prominent in interviewer-administered surveys with primacy effects being more prominent in self-administered

surveys. Thus, it is expected that respondents with low working memory will be more likely to select a later response option in the telephone survey and more likely to select an earlier response option in the web survey. Additionally, as working memory improves, the likelihood of selecting a later response option in telephone or selecting an earlier response option in web should decrease for respondents of all ages.

In 1997, Knäuper et al. used data from the Assets and Health Dynamics among the Oldest Old (AHEAD), a survey that has since been merged with the Health and Retirement Study (HRS). This research assessed the impact of question difficulty and cognitive ability on data quality. The authors combined several memory measures from the cognitive ability section of the survey and found that data quality, as measured by "don't know" responses, was impacted by the interaction of cognitive ability and question difficulty. The AHEAD measures included such items as an immediate recall of a list of 10 words, counting backwards from 20, stating the date including day of the week, naming the current U.S. President, and the Serial 7s test (described below). Although the Serial 7s test may have been originally designed to measure working memory, research has shown it does not effectively isolate working memory capacity (Herzog & Wallace, 1997). Thus, due to the doubts of the Serial 7s measure capturing working memory, as well as the measure being combined with other cognitive measures, the findings by Knäuper et al. (1997) may only be generalizable to cognitive ability overall rather than specifically working memory capacity.

The Serial 7s measure, originally used in the Mini-Mental State Exam (Folstein, Folstein, & McHugh, 1975) and subsequently in the AHEAD, HRS, and other surveys, requires respondents to subtract 7 from 100 and to continue subtracting 7 for a total of

five times. After an introduction to the question, an interviewer presents the question to a respondent by saying, "What is 7 subtracted from 100?" and follows up the respondent's answer with "And 7 subtracted from that number?". The interviewer continues until the respondent has subtracted seven on five occurrences. Unfortunately, many people struggle with innumeracy, defined as "an inability to deal comfortably with the fundamental notions of number and chance" (Paulos, 1988, p.3) or have a mathematical anxiety (Ashcraft & Faust, 1994), both of which may interfere with using mathematical questions to assess working memory. Therefore, the incorporation of mathematical functioning in the Serial 7s test may diminish its ability to effectively measure working memory capacity. In fact, using factor analysis on nine cognitive measures from the AHEAD, Herzog and Wallace (1997) found that the Serial 7s measure did not load onto a separate working memory factor concluding that it may not be an appropriate measure for working memory. The Serial 7s task and other memory measures from the HRS will be included in my dissertation and compared to a composite score of two working memory measures. The expectation is that comparing a subset of HRS memory measures with working memory measures will result in a significant number of respondents being classified differently across the two sets of scores.

My dissertation will build upon the research of Knäuper and her colleagues. In my questionnaire I will utilize simple questions of attitude to extend the findings of working memory differences across younger and older adults. Analyses will examine the impact of age, working memory, and their interaction on response order and question order effects, and will look at the effects in telephone and web, separately and combined, to determine if the effects are present in both modes. I will also compare a subset of HRS

memory measures with the working memory measures of sentence span and alphabet span. This comparison will allow me to determine whether the measures represent the same underlying cognitive constructs and if respondents are categorized differently based on the measures used. Overall, with my dissertation I strive to broaden the understanding of the impact of working memory on the field of survey methodology. Regarding response order effects, I hypothesize that across all ages respondents with low working memory will be more likely to select an early response option in the web mode and a late response option in the telephone mode, and as working memory improves respondents will be less likely to select the response options related to primacy (early-web) and recency effects (late-telephone). It is also hypothesized that there will be an interaction of working memory with mode such that response order effects will be present in both modes but will not be consistent across lower to higher working memory scores. For instance, although overall respondents are likely to select the first response option in web compared to telephone, as working memory improves, respondents will become less likely to select the first response in web and inversely will become more likely to select the first response option in the telephone. Considering question order effects, it is expected that reversing the order of the questions has little to no effect on respondents with lower working memory capacity due to the respondents being less likely to have the first question held in memory when answering the second. Thus, I hypothesize that there will be no difference in the response option endorsed by respondents with low working memory, regardless of the order of questions; however, as working memory improves there should be a difference in the endorsement of a particular response option, resulting in a significant interaction between the answer respondents provide on the first of the two

questions and working memory. For example, on the abortion questions, I expect that the endorsement of legal abortion for a married woman who wants no more children may differ depending on the level of respondents' working memory and whether they endorsed legal abortion when there is a strong chance for birth defect. In comparing working memory scores to scores from the HRS memory measures, there are competing hypotheses. As these measures are potentially capturing different aspects of memory and cognitive ability, one hypothesis is to expect significant differences when comparing the standardized scores across all ages, however, the measures are likely capturing highly related constructs and may not result in significant differences with regard to how the scores represent respondents' working memory capacity.

CHAPTER 2: DATA AND METHODS

2.1 Data Collection and Sample

Data were collected for this research in the fall of 2016 by the Bureau of Sociological Research (BOSR) at the University of Nebraska – Lincoln (UNL). 1,116 of the potential respondents had participated in the Nebraska Annual Social Indicators Survey (NASIS) in previous years and indicated a willingness to participate in future research conducted by or for UNL. The NASIS uses an address based sample (ABS), therefore ABS was used to supplement the sample with an additional 2,584 potential respondents, resulting in a total sample of 3,700 Nebraska residents. Of this sample, 603 completed a survey, 262 by web and 341 by telephone (see the BOSR report in Appendix A for more detail on how respondents were contacted and the reported response rates). Although there may be some selection bias by the former NASIS respondents, this is not expected to have any effect on the results of this study. Prior to being contacted respondents were randomly assigned to an administration mode and version of the questionnaire. Respondents were notified of the mode of the survey upon receiving their first contact, without indication that the survey was being conducted in another mode. Within each mode there were six versions of the questionnaire to accommodate the changing orders of questions and response options (described in more detail later).

The questionnaire was designed to be administered across two administration modes, telephone and web, with the same set of questions administered in both modes. Steps were taken to ensure the questionnaires were comparable across both modes. Questions in the web survey were displayed one per page to guarantee the web respondents were presented one question at a time, similar to the presentation for

telephone respondents. For the administration of the cognitive measures, web respondents were unable to return to the previous page. Although this could not prevent respondents from writing down the words to remember, this safeguard prevented them from reviewing the stimulus again, just as interviewers were unable to repeat the words/statements for the telephone respondents. Both web and telephone respondents received instructions that they would not need to write anything down during the survey. Please see Appendix A for the methodology report from BOSR which contains more detail of the data collection process, including screenshots of all questions from both modes.

2.2 Measures and Variables

The questionnaire began with six questions which asked respondents to provide their attitude on a variety of entertainment topics including their preferences on lists of music, movies, sporting events, books, performances, and attractions. The topic of these questions were selected to be salient across a wide variety of demographics so that participants would become engaged in the survey and more likely to continue through to completion (Dillman, Smyth, & Christian, 2014). This initial set of six questions was included to be used in assessing response order effects. These questions were written specifically for this dissertation, but were not tested prior to the administration of the survey. Three of the questions contained dichotomous response options, and half of the sample was assigned versions of the questionnaire with response options in one order while the other half were assigned versions with responses in the reverse order. The other three questions contained six response options. Schwarz et al. (1989) discussed long lists of response options as being those with five or more response options. Six

response options allowed for the use of a balanced Latin Square design for counterbalancing the response options, resulting in six versions of the questionnaire, which were randomly assigned to the members of the sample. Table 2.1 shows an example how the Latin square design was used for the six response options in the sports question. This design was used for all three of the questions with six response options, and the full rotation of response options is located in Appendix A7 of the BOSR report.

Table 2.1: Latin Square Design Randomization of Response Options

Response Options (Q4)	Version 1	Version 2	Version 3	Version 4	Version 5	Version 6
Basketball (1)	1	2	6	3	5	4
Soccer (2)	2	3	1	4	6	5
Baseball (3)	3	4	2	5	1	6
Hockey (4)	4	5	3	6	2	1
Golf (5)	5	6	4	1	3	2
Volleyball (6)	6	1	5	2	4	3

Using the Latin Square design to counterbalance the order of the response options for each version was a way to minimize the confounding effect of content. For the first six questions there are two variables assigned to the response options, one for the content (e.g., "Basketball") and one for the location within the list of the response options. For example, in version 1 the value for the location of Basketball would be 1, but in version 2, the value for the location would be 6. These variables allow for the location of a response options to be analyzed separate from their content.

On the web survey respondents were provided with a "Don't Know/Refuse" option. During the telephone interviews, along with accepting an offered response of don't know or refuse, interviewers were also able to accept a respondent's answer of not participating in a particular entertainment, for instance "I don't read". These non-

substantive answers were combined with item non-response, where respondents provide no answer, and are noted as missing in the Chapter 3 tables.

Following the set of entertainment questions, three pairs of questions (six questions total) were included to assess question order effects. The questions were used in previous studies examining question order effects (Knäuper et al., 2007; Schuman & Presser, 1981), with two of the sets of questions, those regarding abortion and labor conditions, being presented verbatim from Knäuper et al. (2007, p.519, p.522). Another set of questions asked respondents about their happiness in life altogether and happiness with their intimate partner. The original question (Schuman & Presser, 1981) asked respondents about their happiness with their marriage, this question was updated to intimate partner to be more inclusive of a larger proportion of the respondents. Respondents for whom this question did not apply were allowed to choose the option "no intimate partner".

For each of these pairs of questions, half of the questionnaire versions asked each pair of questions in one order with the order of presentation being reversed for the other half of the versions. Take the happiness question for example, half of the sample was assigned to receive the overall happiness question first followed by the happiness with an intimate partner question, while the other half of the sample received the happiness with intimate partner question first followed by the happiness overall question. In addition to the variables for the substantive responses, and indicator variable was created for each pair of questions to denote the question order.

Next, respondents were asked a series of questions designed for measuring working memory capacity. To increase the reliability of the working memory score, two

working memory measures were used (Waters & Caplan, 2003), the sentence span and alphabet span tasks. In the sentence span task, respondents were presented a series of short statements. After the presentation of each statement, the respondent indicated the statement to be true or false, and at the end of the series of statements were prompted to repeat back the last word of each statement. This procedure was conducted for a series of three statements and again for series of five statements. Examples of the statements are: "A clock is used to tell time", "Grass is the color blue", and "Birds fly in the sky". These statements were written for this dissertation survey based on the example of sentence span statements used by Freitas et al. (2007), and each word to be remembered is monosyllabic. Similar to the sentence span, the alphabet span task also included a series of three and a series of five. In these series, respondents were presented a list of words and asked to repeat them in alphabetical order. For example, "home, wife, flag" should be repeated by the respondent as "flag, home, wife". The words selected for the alphabet span were chosen from monosyllabic words used in List 2 and List 3 of the Health and Retirement Study (HRS) lists of 10 words to be recalled.

Conway et al. (2005) provide an overview of scoring methods that can be used for working memory measures. Due to there often being ceiling effects for the processing component, one suggestion from the authors is to score the correctly recalled words without taking into consideration the accuracy of the processing component. In fact, the results of the processing components for the respondents in this study show that almost 97% correctly identified true or false on the set of three statements with approximately 92% correctly identifying all five statements correctly in the longer set. On the alphabet task, of those who correctly recalled all of the words approximately 92% in both the set

of three and set of five reported the words in the correct alphabetical order. Therefore, the accuracy of the processing component was not be taken into account for scoring the working memory measures. Three different scoring methods were calculated based on the correct words recalled, the all-or-nothing unit scoring, the partial-credit unit scoring, and the all-or- nothing load scoring. In the *all-or-nothing unit scoring*, respondents received one point for each correctly recalled word, providing equal weighting to each word, allowing for a maximum score of 16 points. In the *partial-credit unit scoring*, each set is worth one point and scoring is assigned based on a proportion of correctly recalled words in the set. For instance, correctly recalling one word in a three word set received a score of 0.33 for the set, recalling two words a score of 0.67, and recalling all three words a score of 1.0. With four sets total (set of three and set of five in each task), there was a maximum of four points for this method. In the *all-or-nothing load* scoring, respondents must correctly recall all words in a set to receive points total to the number of words in the set, anything less results in a score of zero. For example, recalling all three words in a three word set received a score of three for the set, recalling fewer than three words received a score of zero for the set. The maximum score for the all-or-nothing method is 16. The results of the three working memory scoring methods are shown in Table 2.2.

A t-test comparison concluded the mean of the working memory scores to be significantly higher in web than for telephone across all three scoring methods; all-or-nothing unit ($t=12.81$, $p<.0001$), partial-credit unit ($t=11.63$, $p<.0001$), and all-or-nothing load ($t=12.80$, $p<.0001$). Due to the significant differences in the working memory scores in telephone and web there appears to be a mode effect on working memory performance. An assumption was made that the raw scores do not equivalently reflect

the level of working memory capacity across the two modes, therefore working memory scores were also standardized separately within each mode to use throughout the analyses. Thus, calculating the z-scores separately for the modes, a raw score of 12 results in a z-score of 0.2097 in the telephone mode and a z-score of -0.9488 in the web mode.

Table 2.2: Univariate Statistics

	Overall N=601			Telephone N=341			Web N=260		
Continuous	**Mean**	**sd**	**Range**	**Mean**	**sd**	**Range**	**Mean**	**sd**	**Range**
Working Memory:									
All-or-Nothing unit	12.49	2.84	1 - 16	11.38	2.94	1 - 16	13.93	1.92	8 - 16
Partial-Credit unit	3.20	0.67	0.2 - 4	2.96	0.71	0.2 - 4	3.51	0.45	2 - 4
All-or-Nothing load	8.40	4.51	0 - 16	6.60	4.14	0 - 16	10.78	3.83	0 - 16
HRS Memory:									
Exact Values	11.08	2.94	1 - 16	10.44	2.94	1 - 16	11.91	2.86	1 - 16
Correct Subtraction	11.43	2.75	1 - 16	10.87	2.68	1 - 16	12.16	2.69	1 - 16
Age	55.68	15.40	24 - 98	56.60	16.00	24 - 90	54.47	14.53	25 - 98
Categorical	**%**			**%**			**%**		
Education:									
H.S. Grad or less	10.82			12.32			8.85		
Trade/Technical/etc	20.13			22.87			16.54		
Some College	12.65			10.85			15.00		
Bachelor's	29.62			28.74			30.77		
Post Graduate	26.79			25.22			28.85		

Several measures from the HRS were included in the questionnaire to use for comparison to the working memory measures. Included in this set of questions is the Serial 7s questions, described in detail in Chapter 1. Respondents began by subtracting 7 from 100 and continued subtracting 7 for a total of five times. Respondents received two scores for the Serial 7s. The first score is a sum of the correct "exact values". Respondents were also scored on this measure for every "correct subtraction", regardless if the answer in the step before was correct. For example, if a respondent provides an

initial incorrect value of 94 instead of 93, they received a score of 0 for that step in both scoring methods, however, if in the next step they provided a value of 87 this received a score of 1 as a correct subtraction response (94-7=87) but a score of 0 in the exact values scoring method which required an answer of 86. Both scores for the Serial 7s task can range from 0-5 and are combined with the other HRS measures.

Also included in the HRS set of questions were ones which ask respondents to name the current U.S. President and Vice President where respondents were required to provide the last names Obama and Biden, respectively, or their answer was classified as "other". However, the survey was administered in the weeks following the 2016 Presidential election, therefore, the newly elected Donald Trump and Mike Pence were also considered correct responses. Respondents were also asked to provide the name of the object used to usually cut paper. Keeping consistent with HRS, only "scissors" or "shears" were considered a correct response with all other responses classified as "other". Respondents received a score of 1 for each correct response.

In another HRS question, respondents were presented a list of ten words and asked to immediately recall as many as possible. Respondents received a score for each correct word recalled, for a total score range on this question of 0-10. The list of words came from List 1 of the four lists used on the HRS.

Respondents' total HRS memory score was calculated using the recall of 10 words, Serial 7s, and the vice president question, for a range of 0-16. Around 99% of the respondents correctly identified the President and item used for cutting paper, therefore due to the negligible variance in these questions they were omitted from the overall HRS memory score. Two HRS scores were calculated based on the Serial 7s question, one

using the exact values method and the other using the correct subtraction method. The differences in the two HRS scores were tested using a paired t-test and found to be significantly different ($t=-9.48$, $p<.0001$). The average HRS memory scores from both methods are previously shown in Table 2.2.

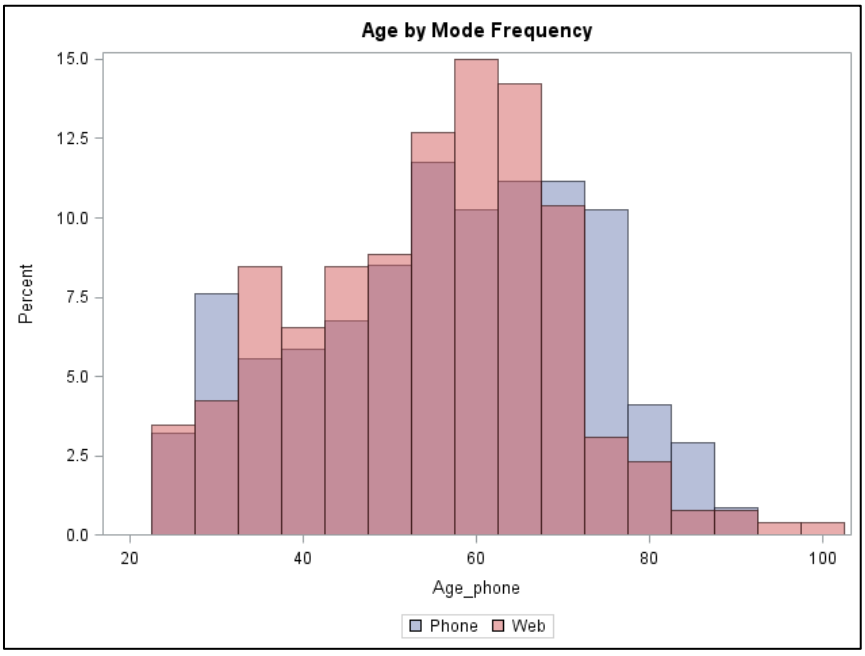
The questions in the memory section required the web participants to type their responses into text boxes. These responses were prone to typing and spelling errors, therefore, the responses for each of these questions were checked for such potential errors. Appendix B shows all misspellings that were accepted as correct responses for each word. For example, "wfe" and "wif" were both accepted for "wife". The telephone survey was designed such that the interviewers were able to check off respondents' answers and recalled words without needing to type in the responses, and therefore the telephone survey was not prone to typing errors.

In addition to the questions described above, several respondent demographics were also collected: age, sex, education and employment, although the current research will only examine the effects of age controlling for education. Education was asked in the telephone mode as an open-ended question with the interviewers classifying responses into one of the following categories, which were the same response options displayed for the web respondents: Less than high school graduate; High school graduate; Some college, but no degree; Technical/Trade/ Community College/Associate's degree; Bachelor's degree (4-year, BS, BA, RN); Post graduate degree (Masters, PhD, Law, Medicine). Table 2.2 includes proportions for the education categories.

Age was asked as an open-ended numeric question. Figure 2.1 shows an overlay of the frequencies of respondent ages for telephone and web. The average age in

telephone ($\bar{x}$=56.60) is slightly higher than the average age in web ($\bar{x}$=54.47) at a marginal significance (t=1.70, p=.09). Overall the sample is skewed slightly to an older demographic with an average age of 55.68 years. Age results are displayed previously in Table 2.2.

Figure 2.1: Frequency Distribution of Respondent Age by Mode



Four respondents did not provide their age, but simple mean imputation based on sex, employment, and education was used for two of the respondents who provided such information. Therefore the final analytic sample size was reduced from 603 to 601. Only six respondents selected "Less than high school graduate" and were combined with the next category to become "High school graduate or less".

Due to the web mode requiring some computer knowledge and skills, there was a concern that the level of education would differ across the modes with respect to respondent ages. Separating the respondents into three age categories (<45, 45-64, 65+), within each category a Chi-squared test was conducted to examine education by mode.

The results show education and mode to be independent within each age category. Table 2.X displays the count and percentages across each mode, by education, and within each age category. Although the test does not reach a significance level, there does appear to be larger differences in some of the raw percentages, particularly in the youngest and oldest age categories regarding the respondents who attended a technical or trade school and among those who have a post graduate degree. Splitting age into five year increments, Figures 2.2 and 2.3 show the frequency distributions of age by education categories for telephone and web, respectively. Additionally, within each education category the mean age of respondents was tested across the two modes. The t-tests, not shown, yielded no significant differences in respondent mean age between telephone and web within the education categories.

Table 2.3: Frequency of Respondent Education by Mode by Respondent Age (<45, 45-64, 65+)

	≤ H.S. grad	Tech/Trade/ Assoc.'s	Some college	Bachelor's degree	Post grad degree	Total	$X^2_{(4)}$	p-value
				Age <45				
Telephone	6 (7.0%)	14 (16.3%)	7 (8.1%)	32 (37.2%)	27 (31.4%)	86	6.96	0.1378
Web	1 (1.5%)	6 (9.2%)	12 (18.5%)	26 (40.0%)	26 (40.0)	65		
Total	7	20	19	58	47	151		
				Age 45-64				
Telephone	17 (12.6%)	27 (20.0%)	24 (17.8%)	37 (27.4%)	30 (22.2%)	135	1.34	0.8545
Web	11 (8.7%)	25 (19.7%)	22 (17.3%)	40 (31.5%)	29 (22.8%)	127		
Total	28	52	46	77	59	262		
				Age 65+				
Telephone	19 (15.8%)	37 (30.8%)	6 (5.0%)	29 (24.2%)	29 (24.2%)	120	6.49	0.1655
Web	11 (16.2%)	12 (17.7%)	5 (7.4%)	14 (20.6%)	26 (38.2%)	68		
Total	30	49	11	43	55	188		

Figure 2.2: Frequency Distribution of Age by Education in Telephone Mode

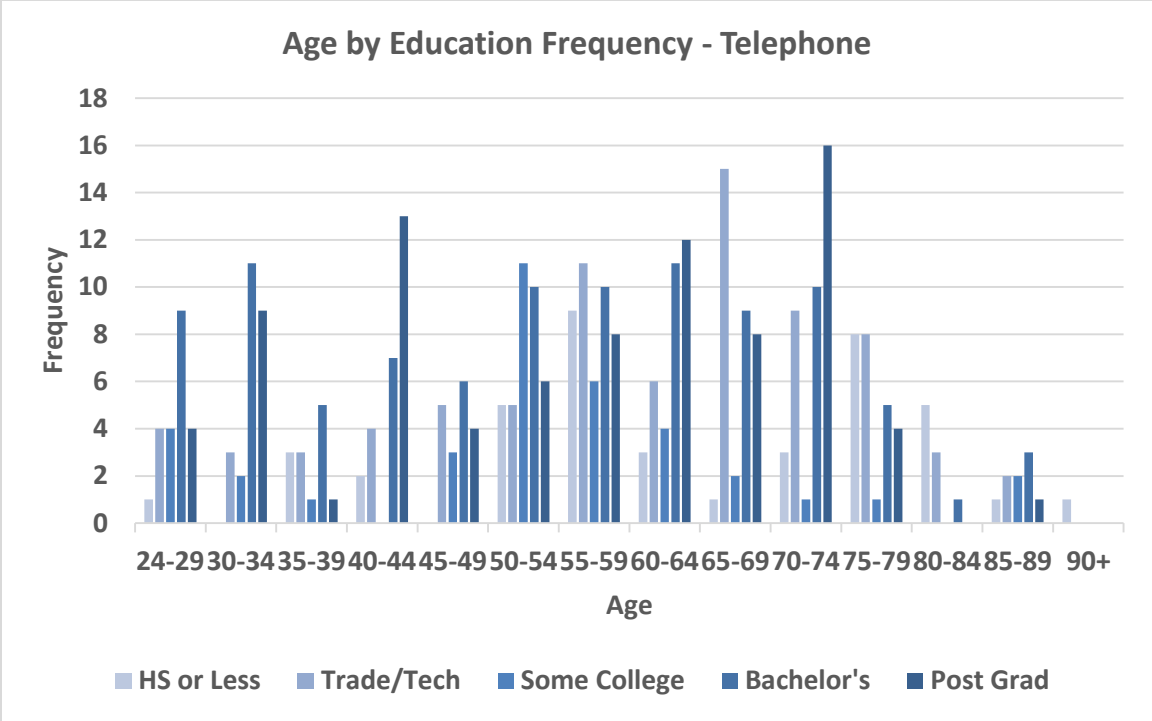
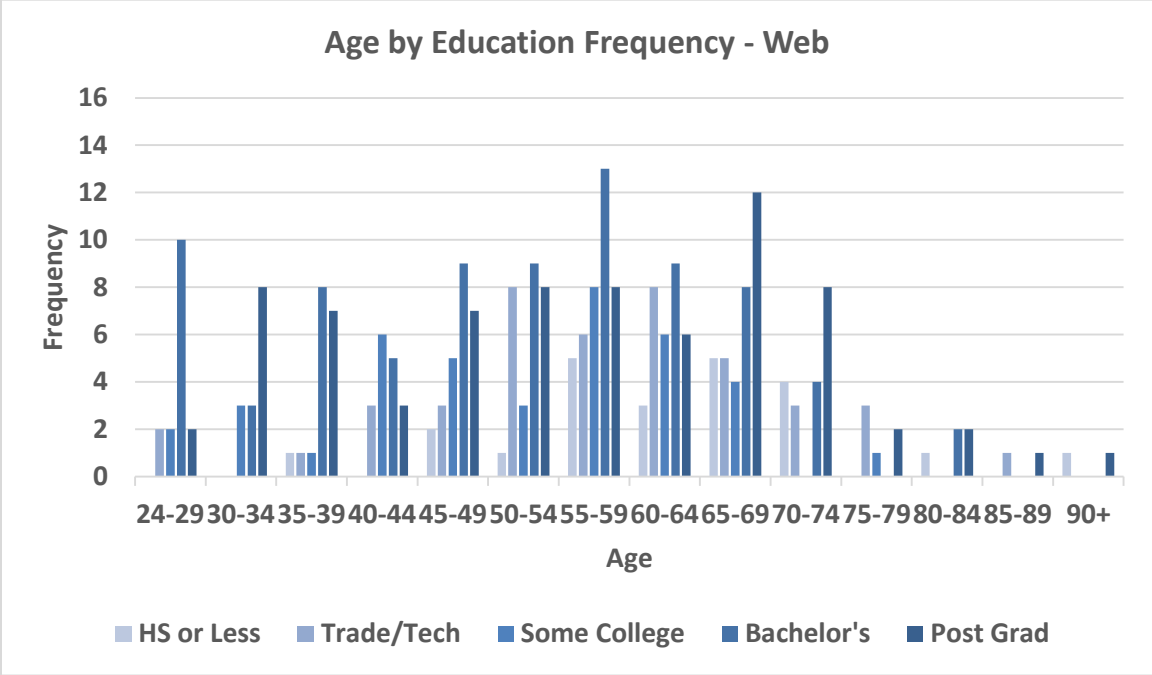


Figure 2.3: Frequency Distribution of Age by Education in Web Mode



Although the sample was evenly split across mode and version, there were slight variations in the number of completed surveys. Table 2.3 displays the number of completed surveys by mode and version.

Table 2.3: Respondents (N) per Survey Mode and Version

Version	Overall	Phone	Web
1	95	53	42
2	108	66	42
3	94	54	40
4	100	57	43
5	101	53	48
6	103	58	45
Total	601	341	260

2.3 Data Analysis Methods

To begin the data analysis process, a simple linear regression was used in examining the relationship between age and working memory to determine if the data reflected the anticipated negative relationship between the two variables. Moving forward, the focus shifted to analyzing the response order effects. Before examining if there were any effects from working memory, Chi-square Test of Independence were conducted using SAS PROC FREQ to determine if there were response order effects in general. For the first three attitudinal questions (Q1-Q3), the Chi-square Test of Independence was used on the two-by-two contingency tables comparing the location of the response option (e.g., first, second) and the substantive response (e.g., fiction, non-fiction). For questions Q4-Q6, there were too many cells with small count sizes to compare the substantive responses to all six response option locations. To increase the cell counts, the response options locations were reduced to three locations by combining

the first and second locations into “early”, the third and fourth locations into “middle”, and the fifth and sixth locations into “late”. Thus, on questions Q4-Q6 the Chi-Square Test of Independence was conducted on a three-by-six table comparing the three condensed locations and the six substantive response options.

Next, the questions with the same number of response options were combined (e.g., Q1-Q3 and Q4-Q6) and analyzed for working memory effects. Using PROC GLIMMIX multilevel logistic regression models (Raudenbush & Bryk, 2002; Snijders & Bosker, 1999) are fitto predict the probability of respondents selecting the first response option while accounting for the repeated measures from combining questions on the same respondents. The models were tested on each mode separately in a two-step process with Model 1 containing the control variables of question and education along with the predictors of age and working memory while Model 2 contains the same variables with the addition of the interaction between age and working memory. After examining the modes separately, the modes were combined together and analyzed, again with multilevel logistic regression models. With the modes combined, a five-step modeling process was used where Model 1 contains only the single controls and predictors (question, education, age, working memory, mode), while Models 2-4 add in one two-way interaction at a time (age*working memory, age*mode, working memory*mode), and finally Model 5 combines all single variables, all two-way interactions, and the three-way interaction of age*working memory*mode. For Q4-Q6, models were tested predicting both an early response, compared to middle and late combined, and also predicting a late response, compared to early and middle combined. The general 2-level model accounting for

questions (i) nested within respondents (j) is shown, where $V_j \sim N(0, \sigma_v^2)$ and $U_{ij} \sim N(0, \sigma_u^2)$.

$$logit\,[P(location = 1)] = \hat{\beta}_{00} + \hat{\beta}_{10}Question + \hat{\beta}_{01}Education + \hat{\beta}_{02}Age + \hat{\beta}_{03}WM + \hat{\beta}_{04}Mode + \hat{\beta}_{05}Age * WM + \hat{\beta}_{06}Age * Mode + \hat{\beta}_{07}WM * Mode + \hat{\beta}_{08}Age * WM * Mode + V_j + U_{ij}$$

To assess overall question order effects, the pairs of questions were first analyzed using Chi-Square Tests of Independence to determine if the endorsement rates differ for the two presentation orders. In addition, the correlation coefficients for the responses to both questions were examined to assess whether the correlations differ for the presentation orders. For example, in the general-specific scenario it was expected that the correlation between the answers will be lower when the specific question is presented first.

The next step was to assess whether working memory has an impact on how respondents answer the second of the two related questions. Using SAS PROC GLIMMIX logistic regression was used for predicting the positive response option for the second question. Controlling for education the predictors in the model include age, working memory, response to the first question, and all interactions between the predictors. A five model sequence was used by including only the individual predictors in in Model 1, Models 2-4 included the two-way interactions (age*working memory, age*1st response, working memory*1st response) one at a time, and Model 5 included all two-way interactions and the three-way interaction (age*working memory*1st response). The general logistic regression model is shown where $e_i \sim N(0, \sigma_e^2)$.

$$logit\,[P(Respnse = \text{"}VERY\ HAPPY\text{"}/\text{"}YES\text{"})] =$$

$$\hat{\beta}_0 + \hat{\beta}_1 Education + \hat{\beta}_2 Age + \hat{\beta}_3 WM + \hat{\beta}_4 First\ Response + \hat{\beta}_5 Age * WM + \hat{\beta}_6 Age * First\ Response + \hat{\beta}_7 WM * First\ Response + \hat{\beta}_8 Age * WM * First\ Response + e_i$$

A series of tests was used for a more comprehensive comparison of the working memory measures. Due to the significant differences between the scores of the HRS measures, as shown in the previous section, both sets of HRS scores were compared to the working memory measures. The measures were first compared with a paired t-test to determine if there is a significant difference between the means of the raw scores. Next, a simple linear regression was used to examine the correlation of the scores. If the measures are representative of the same underlying construct the scores should be highly correlated. The next step was to split the respondents into high and low categories for the working memory and HRS measures, using both a mean and median split, then compared the percentage of respondents who are classified differently. For instance, determining if there are respondents who are classified as having a high working memory but fall into the low category for the HRS measures. The final step in comparing the measures was to select a response order model where working memory is a significant predictor substituting the HRS scores into the model for the working memory scores. This process will show whether the model yields similar results from the different sets of measures.

CHAPTER 3: RESPONSE ORDER EFFECTS

3.1 Relationship between Working Memory and Age

Before analyzing the response order effects, the data were examined to get an overall understanding of the bivariate relationship between age and all three working memory scoring methods (refer to Chapter 2). Looking first at the all-or-nothing unit scoring method, there is a significant negative relationship between age and working memory in both modes (telephone: t=-7.70, p<.0001, r=-.39; web: t=-2.85, p=.0048, r=-.17). Figures 3.1 and 3.2 show the scatterplots, with overlying regression line, for age by working memory (all-or-nothing unit method) in telephone and web, respectively. The all-or-nothing unit method is highly correlated with the partial-credit unit method and in both the telephone (r=.99) and web (r=.98) modes. Not surprisingly then, this partial-credit method of scoring working memory also results in a similar significant negative relationship with working memory (telephone: t=-7.98, p<.0001, r=-.40; web: t=-2.88, p=.0044, r=-.18). These scoring methods which reward respondents for each correct word produce similar correlations (in the telephone mode) to the age and working memory correlations presented in Chapter 1, which ranged from -.38 to -.49. While the correlation in the web mode is smaller than reported in other studies, this may in part be due to differences in the administration of the measures, which were conducted in controlled environments in the earlier studies[1] (compared to the current study where respondents completed the survey on their own devices and environments, away from the researcher). The all-or-nothing load method, where respondents were penalized for

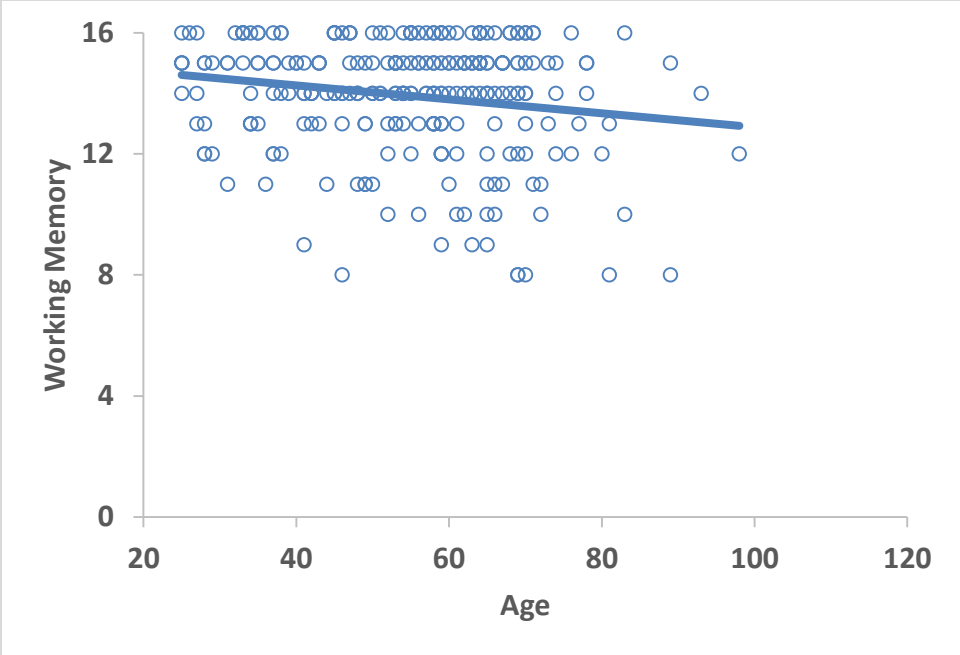
[1]Knäuper and Wittchen (1994) refer to items presented verbally. Caplan et al. (2011) refer to respondents reading sentences. Caplan and Waters (2005) denote the alphabet and subtract 2 were verbal while both sentence spans were reading tasks.

incomplete sets, is also highly correlated with the all-or-nothing unit method, although to a lesser degree (telephone: r=.82; web: r=.83), and the correlations with age are also lower compared to both unit scoring methods (telephone: t=-6.52, p<.0001, r=-.33; web: t=-1.71, p=.0888, r=-.11).

Having compared the three working memory scoring methods and their relationship with age, moving forward all analyses will include the all-or-nothing unit scoring method (one point per word). This method of assigning scores at the unit level with equal weighting is recommended by Conway et al. (2005), it is highly correlated with the partial-credit unit method, and has similar correlations with age as earlier studies.

Figure 3.1: Age by Working Memory (All-or-Nothing Unit Method) – Telephone

Figure 3.2: Age by Working Memory (All-or-Nothing Unit Method) – Web



3.2 Dichotomous Response Options

The three questions with dichotomous response options were first analyzed for overall response order effects within each mode. The order of the response options for these questions were reversed on the even and odd versions of the questionnaire. For example, in the even versions the first question about book preference presented the options as fiction then non-fiction while in the odd versions they were presented as non-fiction then fiction. Reversing the response options controls for the substantive content of the options such that the same option is not always presented in the same location.

Tables 3.1-3.3 show the percentage of respondents selecting each substantive response option by the order in which the response option was listed, the first location or the second location. For instance, of the respondents in the telephone mode who selected fiction as their book preference, 46.5% selected the response option when it came first

and 53.5% selected fiction when it was listed second. The number of missing values are noted in the tables for each question where respondents did not provide a substantive response.

Chi-square test of independence was used to determine if there were differences in the rate of endorsement regarding the order in which the response options were presented. For each of the first three questions, the substantive response option and the response option location are independent ($p>.05$). In other words, respondents made their substantive selection regardless of whether their preference was listed first or second. Therefore, for this set of questions with dichotomous response options there are no overall response order effects. Chi-square test of independence was also conducted to determine if the selection rates of the locations differed across mode. The results (not shown) indicate location and mode are independent for all three questions (p>.05). For instance, combining both substantive options in the book preference question, 49.7% of respondents selected the first option in the telephone mode and 51.0% selected the first option in the web condition.

Table 3.1: Response Selections – Location by Book Preference by Mode (Q1), Chi-square

	Phone[a]			Web[b]		
	Fiction	Non-Fiction	Total	Fiction	Non-Fiction	Total
Location 1	67 (46.5%)	88 (52.4%)	155 (49.7%)	66 (52.0%)	64 (50.0%)	130 (51.0%)
Location 2	77 (53.5%)	80 (47.6%)	157 (50.3%)	61 (48.0%)	64 (50.0%)	125 (49.0%
Total	144	168	312	127	128	255
	X^2=1.0626, df=1, p=0.3026			*X^2=0.0988, df=1, p=0.7532*		

[a]Missing=29, [b]Missing=5

Table 3.2: Response Selections – Location by Movie Preference by Mode (Q2), Chi-square

	Phone[a]			Web[b]		
	Action	Drama	Total	Action	Drama	Total
Location 1	66 (47.5%)	99 (54.7%)	165 (51.6%)	57 (51.4%)	69 (50.4%)	126 (50.8%)
Location 2	73 (52.5%)	82 (45.3%)	155 (48.4%)	54 (48.7%)	68 (49.6%)	122 (49.2%)
Total	139	181	320	111	137	248
	X^2=4.6383, df=1, p=0.2006			*X^2=0.0239, df=1, p=0.8772*		

[a]Missing=21, [b]Missing=12

Table 3.3: Response Selections – Location by Performance Preference by Mode (Q3), Chi-square

	Phone[a]			Web[b]		
	Broadway Musical	Classical Ballet	Total	Broadway Musical	Classical Ballet	Total
Location 1	114 (44.7%)	19 (52.8%)	133 (45.7%)	94 (47.5%)	6 (37.5%)	100 (46.7%)
Location 2	141 (55.3%)	17 (47.2%)	158 (54.3%)	104 (52.5%)	10 (62.5%)	114 (53.3%)
Total	255	36	291	198	16	214
	X^2=0.8283, df=1, p=0.3628			*X^2=0.5917, df=1, p=0.4418*		

[a]Missing=50, [b]Missing=46

Although there appear to be no overall response order effects on the first three questions, the data for questions Q1-Q3 were combined and analyzed to determine if there are any differences in the location of the selected response option across age, working memory[2], and mode, controlling for education and question. The questions were first analyzed using multilevel logistic regression models within each mode predicting the probability of respondents selecting the first response, accounting for the repeated measures from combining the three questions. Model 1 examined only predictor variables (age and working memory) and control variables (question and education) with Model 2 including the interaction between age and working memory. The results of the models are shown in Table 3.4. The expectation is that respondents with lower working

[2] Models in this chapter use the standardized working memory scores. Models where mode is separate were tested with raw working memory scores and show differences on age only, for some of the models.

memory capacity would be more susceptible to response order effects compared to respondents with higher working memory capacity.

For the web mode, it is expected that as working memory improves respondents would be less likely to select the first option, however, there is no significant impact from working memory, either as an individual predictor or as an interaction with age. There is a significant age effect which is in line with previous research that has shown older adults are more likely to exhibit primacy effects in self-administered surveys. The significant age effect ($\hat{\beta}_{02}$=0.016, SE=0.006, p=0.0053) in the web mode indicates that for a one-year increase in age respondents are 1.02 ($e^{\hat{\beta}}$) times more likely to select the first response. The age effect remains significant ($\hat{\beta}_{02}$=0.015, SE=0.006, p=0.0060) even after including the interaction term.

In the telephone mode with only two responses, it is expected that an increase in working memory would result in respondents being less likely to select the last response (and more likely to select the first response). Looking at the telephone mode there is a marginally significant age by working memory interaction ($\hat{\beta}_{05}$=-0.007, SE=0.004, p=0.0974). Figure 3.3 shows the estimated probabilities of selecting the first response in the telephone mode for ages 25-85 when the age by working memory interaction term is included (Model 2). Among older adults (65-85), as working memory increases, there is a decrease in the probability of selecting the first response. This result is contrary to the hypothesis that an improvement in working memory would increase the likelihood of selecting the first response. Respondents at the age of 55 have only a 3% increase in probability of selecting the first response in the telephone mode as working memory improves from the lowest to highest standardized scores. For the younger respondents

(25-45), results are in line with expectations such that there is an increase in the probability of selecting a first response as working memory improves. The expectation is that an increase in working memory will help all respondents, regardless of age, such that it is more likely they will select an early response in phone compared to the last response heard (ie., decrease the likelihood of recency effects). The expectation is met for the younger respondents. However, an improved working memory has an inverse effect on older respondents who are less likely to choose the first response, and therefore, with only two response options are more likely to choose the last option presented by the interviewer. Overall, in a dichotomous attitudinal question, having a better working memory appears to aid younger respondents in selecting the first response they hear, compared to the last response, but does not help older respondents.

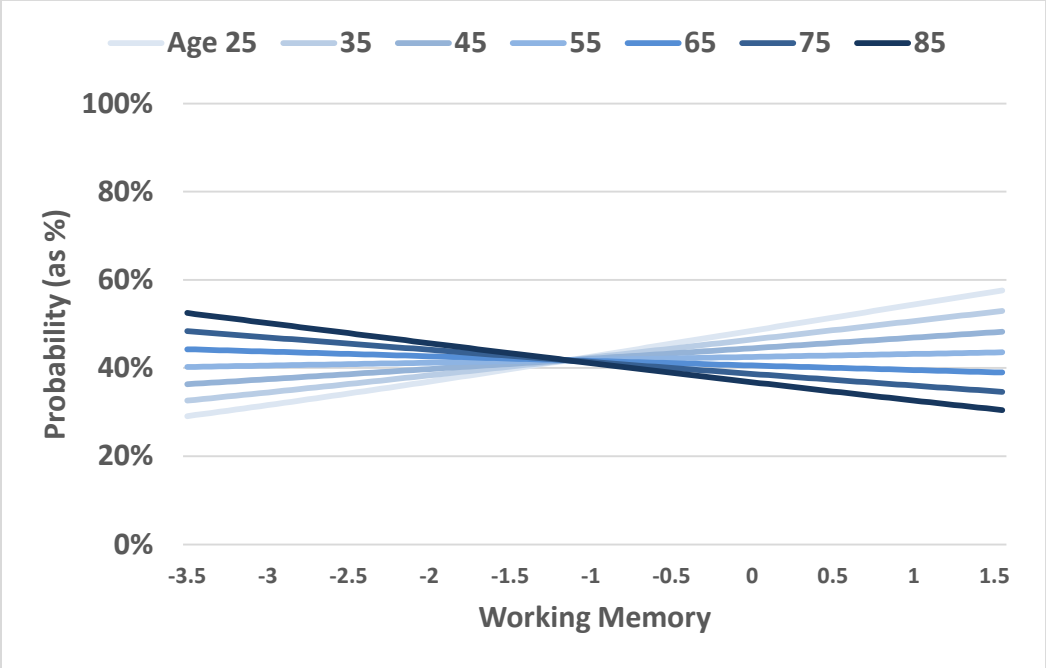
Table 3.4: Multilevel Logistic Regression – Predicting the Probability of Selecting the First Response Option (Across Q1-Q3) – by Mode

	Telephone[a]				Web[b]			
	Model 1		Model 2		Model 1		Model 2	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Intercept	0.189	0.35	0.151	0.336	-0.774 +	0.449	-0.746 +	0.450
Question Number:								
(Ref) Q1	--	--	--	--	--	--	--	--
Q2	0.071	0.160	0.076	0.160	-0.002	0.180	-0.007	0.180
Q3	-0.164	0.164	-0.163	0.164	-0.159	0.395	-0.159	0.187
Education:								
(Ref) ≤ H.S. grad	--	--	--	--	--	--	--	--
Tech/Trade/Assoc.'s	0.184	0.226	0.174	0.226	-0.205	0.324	-0.223	0.325
Some college	0.407	0.274	0.407	0.274	0.172	0.334	0.140	0.336
Bachelor's degree	0.015	0.225	-0.012	0.226	-0.056	0.304	-0.050	0.304
Post grad degree	0.038	0.230	0.017	0.231	-0.047	0.301	-0.036	0.301
Age	-0.005	0.004	-0.008	0.004	0.016 **	0.006	0.015 **	0.006
Working Memory	-0.033	0.073	0.412	0.278	-0.004	0.084	-0.345	0.348
Age*WM			-0.007 +	0.004			0.006	0.006
Respondent Variance	-0.162	0.102	-0.165	0.102	0.041	0.134	0.043	0.134
-2 Res.Log Likelihood	3941.58		3953.68		3063.25		3072.72	
Generalized X^2	966.02		966.91		709.46		709.03	

+p<.10, *p<.05, **p<.01

[a]Observations = 923; [b]Observations = 717

Figure 3.3: Estimated Probability of Selecting First Response Option (Q1-Q3) - Telephone



Next, the data were combined across both telephone and web using multilevel logistic regression to assess age, working memory, mode, and their interactions in predicting whether respondents will select the first response option. Several models were analyzed beginning with the control variables and individual predictors only (Model 1), next examining the two-way interactions (age*working memory, age*mode, working memory*mode) one-by-one (Models 2-4), then including all two-way interactions plus the three-way interaction (age*working memory*mode) into the same model (Model 5). To account for the repeated measures within respondents a multilevel approach was used, and the estimated (non-significant) variance attributed to the respondents is reported for each model. The results of the models are shown in Table 3.8. When combining the modes together, it is expected that respondents will be more likely, overall, to select a first response in the web mode compared to the telephone mode. Regarding working

memory and age, it is expected that an improvement in working memory will benefit respondents of all ages such that the likelihood of selecting the first response will increase in telephone and decrease in web.

The results from Model 5 indicate a marginally significant three-way interaction of age, working memory, and mode ($\hat{\beta}_{08}$=0.012, SE=0.007, p=.0938), with a significant two-way interaction of age by mode ($\hat{\beta}_{06}$=0.020, SE=0.007, p=.0029). Even after accounting for the other variables and interactions, mode continues to have a significant effect ($\hat{\beta}_{04}$=-1.050, SE=0.390, p=.0071). From Figures 3.4 and 3.5 it is clear to see the differences between the two modes.

In the telephone mode (Figure 3.4), the predicted probabilities range from around 33% to 61%. An improvement in working memory is expected to increase the likelihood of selecting the first response for the respondents in the telephone mode. For younger respondents there is an increase in likelihood of selecting the first response, however, contrary to expectations, the likelihood of selecting the first response for older respondents decreases as working memory improves.

Although the chi-square tests did not reveal an overall response order effect for web, Figure 3.5 shows that respondents of all ages and levels of working memory have a predicted probability of 55% or greater of selecting the first response. In terms of how the predicted probabilities vary across age and working memory, respondents with lower working memory show very little variability around the 70% predicted probability of selecting a first response. An improvement in working memory helps younger respondents by slightly by decreasing the likelihood of selecting a first response, but for older adults the likelihood increases slightly.

Overall, the results from the dichotomous questions show there to be a significant interaction between age and working memory within the telephone mode, and a significant three-way interaction of age, working memory and mode when the modes are combined. It is unclear why expectations are met in the telephone mode for younger adults only with the interaction of working memory and age has an inverse effect for the older adults. While there seems to be some slight differences in the estimated probabilities for web when the modes are combined, a significant working memory effect is not present in the web mode when analyzed separately from telephone. This lack of working memory effect in web may be attributed, in part, to the minimal visual separation of only two response options which could be in the same foveal vision of respondents requiring minimal eye movement to expend attention to both responses.

Table 3.5: Multilevel Logistic Regression – Predicting the Probability of Selecting the First Response Option (Across Q1-Q3) – Combined Modes

	Model 1		Model 2		Model 3			Model 4		Model 5		
	Coef.	SE	Coef.	SE	Coef.		SE	Coef.	SE	Coef.		SE
Intercept	-0.222	0.272	-0.235	0.273	0.232		0.308	-0.224	0.272	0.205		0.313
Question Number:												
(Ref) Q1	--	--	--	--	--		--	--	--	--		--
Q2	0.040	0.119	0.042	0.119	0.041		0.119	0.041	0.119	0.041		0.119
Q3	-0.161	0.123	-0.161	0.123	-0.160		0.123	-0.160	0.123	-0.160		0.123
Education:												
(Ref) ≤ H.S. grad	--	--	--	--	--		--	--	--	--		--
Tech/Trade/Assoc.'s	0.035	0.186	0.036	0.186	0.073		0.185	0.031	0.186	0.035		0.186
Some college	0.302	0.208	0.308	0.209	0.303		0.208	0.289	0.210	0.295		0.210
Bachelor's degree	-0.022	0.180	-0.026	0.180	0.007		0.180	-0.030	0.181	-0.015		0.181
Post grad degree	0.012	0.181	0.008	0.181	0.012		0.181	0.001	0.182	0.010		0.182
Age	0.003	0.003	0.003	0.003	-0.005		0.004	0.003	0.003	-0.005		0.004
Working Memory	-0.005	0.054	0.117	0.213	-0.022		0.054	0.017	0.071	0.392		0.283
Mode:												
(Ref) Telephone	--	--	--	--	--		--	--	--	--		--
Web	0.017	0.098	0.023	0.099	-1.095	**	0.374	0.021	0.099	-1.05	**	0.390
Age*WM			-0.002	0.003						-0.007		0.004
(Ref) Age*Phone					--		--			--		--
Age*Web					0.020	**	0.007			0.020	**	0.007
(Ref) WM*Phone								--	--	--		--
WM*Web								-0.050	0.106	-0.679		0.432
(Ref)Age*WM*Phone										--		--
Age*WM*Web										0.012	+	0.007
Respondent Variance	-0.069	0.080	-0.067	0.080	-0.084		0.080	-0.067	0.080	-0.083		0.081
-2 Res.Log Likelihood	6972.65		6982.30		6991.91			6975.35		7015.28		
Generalized X^2	1669.89		1668.91		1677.58			1668.95		1676.77		

$^{+}$p<.10, *p<.05, **p<.01
Observations = 1640

Figure 3.4: Estimated Probability Predicting First Response Option (Q1-Q3) Model 5 – Telephone

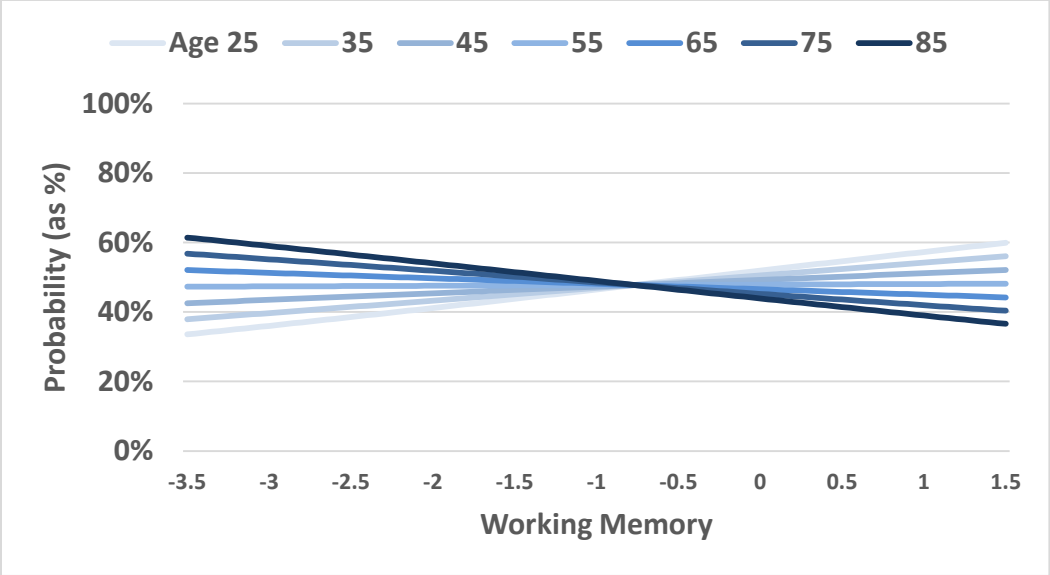
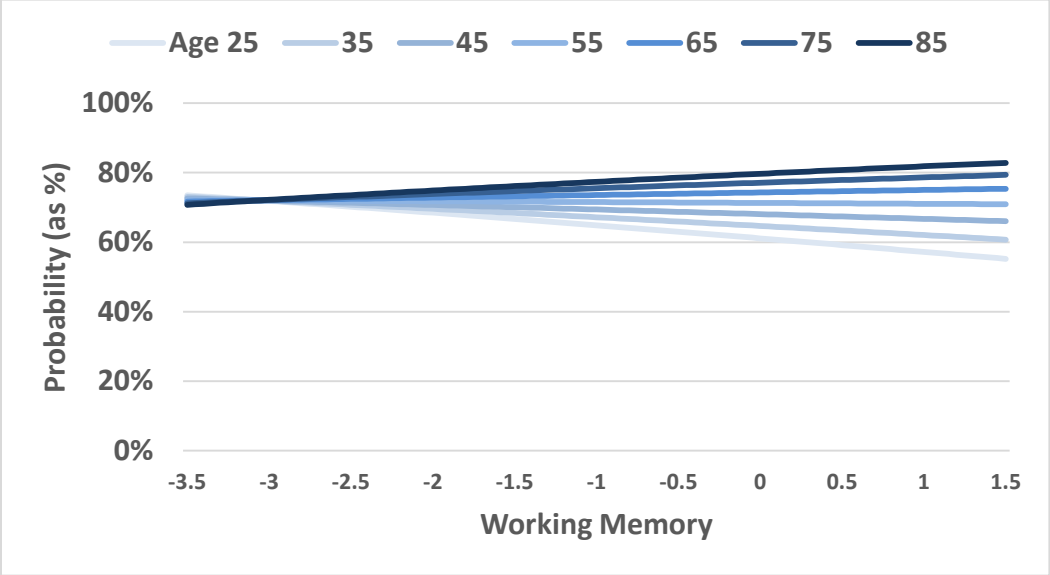


Figure 3.5: Estimated Probability Predicting First Response Option (Q1-Q3) Model 5 – Web



3.3 Long List (Six) Response Options

Moving on from the dichotomous response options, the next set of analyses consider the three questions with six response options. For questions Q4-Q6, the frequencies of the cells were too small when separated into telephone and web for a chi-square test of independence to be valid. Thus, to increase the cell sizes, the locations were grouped into thirds, with locations one and two being combined as "early", locations three and four combined as "middle", and locations five and six combined as "late". Tables 3.6-3.8 display the frequency (and percentage) of endorsements for each substantive option across the early, middle, or late locations. For example, regarding music preference (Q4), of the 106 respondents in the telephone mode who selected rock as their favorite music 29.3% selected the option when it was listed early (first or second), 26.4% selected the option when it was listed in the middle (third or fourth), and 44.3% selected the option when it was listed late (fifth or sixth). Chi-square test of independence indicate that location and substantive content are independent ($p>.05$) within each mode across all three questions. Examining the rates of endorsement for the location of the response options across both modes, excluding the substantive content, the Chi-square test of independence results (not shown) indicate location and mode are independent for all three questions ($p>.05$). For instance, collapsing across all substantive choices on the music preference question (Q4), in telephone and web modes, respectively, 30.8% and 26.2% of the respondents selected an early response option, 31.2% and 37.5% selected a middle response, and 38.0% and 36.3% selected a late response.

Table 3.6: Response Selections – Location by Music Preference by Mode (Q4), Chi-square

	Telephone[a]						
	Rock	Country	Pop	Rap	R&B	Gospel	Total
Early	31 (29.3%)	33 (33.0%)	21 (36.2%)	3 (42.9%)	3 (14.3%)	8 (27.6%)	99 (30.8%)
Middle	28 (26.4%)	39 (39.0%)	11 (19.0%)	2 (28.6%)	8 (38.1%)	12 (41.4%)	100 (31.2%)
Late	47 (44.3%)	28 (28.0%)	26 (44.8%)	2 (28.6%)	10 (47.6%)	9 (31.0%)	122 (38.0%)
Total	106	100	58	7	21	29	321
[a]Missing 20							χ^2=15.4015, *df*=10, *p*=0.1181

	Web[b]						
	Rock	Country	Pop	Rap	R&B	Gospel	Total
Early	27 (30.0%)	18 (25.0%)	12 (26.7%)	1 (14.3%)	4 (22.2%)	3 (18.8%)	65 (26.2%)
Middle	36 (40.0%)	24 (33.3%)	17 (37.8%)	2 (28.6%)	8 (44.4%)	6 (37.5%)	93 (37.5%)
Late	27 (30.0%)	30 (41.7%)	16 (35.6%)	4 (57.1%)	6 (33.3%)	7 (43.8%)	90 (36.3%)
Total	90	72	45	7	18	16	248
[b]Missing 12							χ^2 n*ot valid*

Table 3.7: Response Selections – Location by Sports Preference by Mode (Q5), Chi-square

	Telephone[a]						
	Basketball	Soccer	Baseball	Hockey	Golf	Volleyball	Total
Early	22 (36.1%)	5 (26.3%)	31 (47.7%)	8 (26.7%)	6 (23.1%)	37 (33.0%)	109 (34.8%)
Middle	18 (29.5%)	4 (21.1%)	15 (23.1%)	9 (30.0%)	12 (46.2%)	41 (36.6%)	99 (31.6%)
Late	21 (34.4%)	10 (52.6%)	19 (29.2%)	13(43.3%)	8 (30.8%)	34 (30.4%)	105 (33.5%)
Total	61	19	65	30	26	112	313
[a]Missing 28							χ^2=13.8117, *df*=10, *p*=0.1818

	Web[b]						
	Basketball	Soccer	Baseball	Hockey	Golf	Volleyball	Total
Early	16 (33.3%)	9 (69.2%)	17 (27.9%)	7 (41.2%)	11 (52.4%)	29 (40.9%)	89 (38.5%)
Middle	13 (27.1%)	2 (15.4%)	19 (31.2%)	5 (27.4%)	4 (19.1%)	24 (33.8%)	67 (29.0%)
Late	19 (39.6%)	2 (15.4%)	25 (41.0%)	5 (29.4%)	6 (28.6%)	18 (25.4%)	75 (32.5%)
Total	48	13	61	17	21	71	231
[b]Missing 29							χ^2=13.2969, *df*=10, *p*=0.2075

Table 3.8: Response Selections – Location by Attraction by Mode (Q6), Chi-square

	Telephone[a]						
	Art Museum	Amusement Park	Historical Monument	State Capitol	Science Museum	National Park	Total
Early	11 (35.5%)	23 (33.3%)	23 (44.2%)	2 (28.6%)	9 (30.0%)	63 (34.2%)	120 (35.3%)
Middle	9 (29.0%)	11 (30.6%)	16 (30.8%)	1 (14.3%)	9 (30.0%)	61 (33.2%)	107 (31.5%)
Late	5 (35.5%)	13 (36.1%)	13 (25.0%)	3 (57.1%)	12 (40.0%)	60 (32.6%)	113 (33.2%)
Total	31	36	52	7	30	185	340
[a]Missing 1							χ^2=5.3577, *df*=10, *p*=0.8660

	Web[b]						
	Art Museum	Amusement Park	Historical Monument	State Capitol	Science Museum	National Park	Total
Early	6 (30.0%)	17 (34.7%)	14 (35.9%)	0 (0%)	10 (30.3%)	37 (31.9%)	84 (32.7%)
Middle	8 (40.0%)	14 (28.6%)	10 (25.6%)	0 (0%)	9 (27.3%)	39 (33.6%)	80 (31.1%)
Late	6 (30.0%)	18 (36.7%)	15 (38.5%)	0 (0%)	14 (42.4%)	40 (34.5%)	93 (36.2%)
Total	20	49	39	0	33	116	257
[b]Missing 3							χ^2=2.4013, *df*=8, *p*=0.9662

Similar to the first three questions, Q4-Q6 were analyzed for telephone and web separately to determine the effects, if any, of age and working memory. However, for this set of questions, models were tested predicting an early response option (compared to middle/late) and separate models predicting a late response (compared to early/middle). The expectations for this section are the same as the previous sections, such that as working memory improves respondents in the telephone survey should be less likely to select an a late response and more likely to select an early response, while respondents in the web should be more likely to select a late response and less likely to select an early response.

The modes were initially tested separately before combining them together. Results of the separate models predicting the likelihood of selecting early and late responses are displayed in Table 3.9. Contrary to expectations and results from the previous section, age and working memory have no significant effect on the selected response location in the telephone mode for the questions with a long list of response options.

In the web mode, there is a significant two-way interaction between age and working memory both for predicting early ($\hat{\beta}_{05}$=0.017, SE=0.0.009, p=.0593) and late responses ($\hat{\beta}_{05}$=-0.016, SE=0.006, p=.0110). Even after accounting for the age by working memory interaction, working memory remains as a significant predictor such that overall as working memory increases by one standard error respondents are half as likely to select an early response ($\hat{\beta}_{03}$=-0.799, SE=0.372, p=.0322) and 2.6 times more likely to select a late response ($\hat{\beta}_{03}$=0.974, SE=0.375, p=.0096). Thus, overall in the web mode an improved working memory benefits respondents such that they are less

susceptible to selecting the early response options. This finding provides evidence to support the hypothesis.

For the web mode, Figure 3.6 shows the estimated probabilities of selecting an early response. The expectation is that as working memory improves, respondents across all ages will be less likely to select one of the early response options in the web mode, and this expectation is met for respondents under 65 years old. For the majority of the respondents, as their working memory improves, the probability of selecting an early response declines considerably. For instance, at age 25 with the lowest working memory score there is a 68% chance a respondents will select an early response compared to only a 16% chance for a respondent of the same age with the highest working memory score. Respondents at the age of 65 remain constant while the older respondents, ages 75+, do have a slight increase in the probability of selecting an early response. Respondents at 85 years old have a 12% probability of selecting an early response with low working memory increasing to 29% with high working memory. Although for respondents with a high working memory, there is only a 17% difference in the estimated probabilities of selecting an early response in web between the youngest and oldest respondents. Thus, in terms of predicting the likelihood selecting an early response in the web, an improved working memory largely benefits most of the respondents while having less of an effect on the oldest respondents, ages 75 and older.

Now turning to predicting a late response in the web version, Figure 3.7 displays the significant interaction between age and working memory. For respondents under the age of 65, as their working memory improves, the probability of selecting a late response increases, contrary to respondents 65 years and older whose probability of selecting a late

response decreases as working memory improves. Thus, even though overall working memory increases the likelihood of selecting a late response in web, an improved working memory does not benefit the respondents ages 65 and older.

While there is no significant impact of working memory in the telephone mode, the results from the web support expectations for respondents under 65 years old. For these respondents in the web mode, an improved working memory decreased the likelihood of selecting an early response and increased the likelihood of selecting a late response. However, on the contrary, for respondents over 65 years old (and in particular over 75), as working memory improves they are more likely to select an early response and less likely to select a late response in the web.

Table 3.9: Multilevel Logistic Regression (Across Q4-Q6) – by Mode [3]

	Telephone[a]				Web[b]			
	Early Response		Late Response		Early Response		Late Response	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Intercept	-0.817 *	0.373	-0.393	0.361	-0.637	0.483	-0.733	0.479
Question Number:								
(Ref) Q4	--	--	--	--	--	--	--	--
Q5	0.184	0.170	-0.200	0.167	0.582 **	0.200	-0.192	0.195
Q6	0.206	0.167	-0.212	0.164	0.320	0.198	-0.013	0.187
Education:								
(Ref) ≤ H.S. grad	--	--	--	--	--	--	--	--
Tech/Trade/Assoc.'s	0.221	0.257	-0.099	0.253	-0.249	0.350	0.214	0.344
Some college	-0.085	0.310	-0.289	0.308	-0.187	0.360	0.109	0.359
Bachelor's degree	0.073	0.259	-0.010	0.253	-0.188	0.324	0.201	0.321
Post grad degree	-0.230	0.268	0.281	0.256	0.071	0.318	-0.119	0.321
Age	-0.000	0.005	-0.002	0.005	-0.005	0.006	0.001	0.006
Working Memory	0.105	0.303	-0.260	0.295	-0.799 *	0.372	0.974 **	0.375
Age*WM	-0.001	0.005	0.004	0.005	0.012 +	0.006	-0.016 *	0.006
Respondent Variance	0.148	0.133	0.103	0.127		0.159	0.175	0.154
-2 Res.Log Likelihood	4259.29		4246.50		3250.52		3218.33	
Generalized X^2	932.06		944.55		699.78		701.59	

+p<.10, *p<.05, **p<.01;
[a]Observations=974, [b]Observations=736

[3] Models excluding age*working memory interaction have no significant terms. Models using the raw working memory scores yield the same results.

Figure 3.6: Estimated Probability Predicting Early Response Option (Q4-Q6) - Web

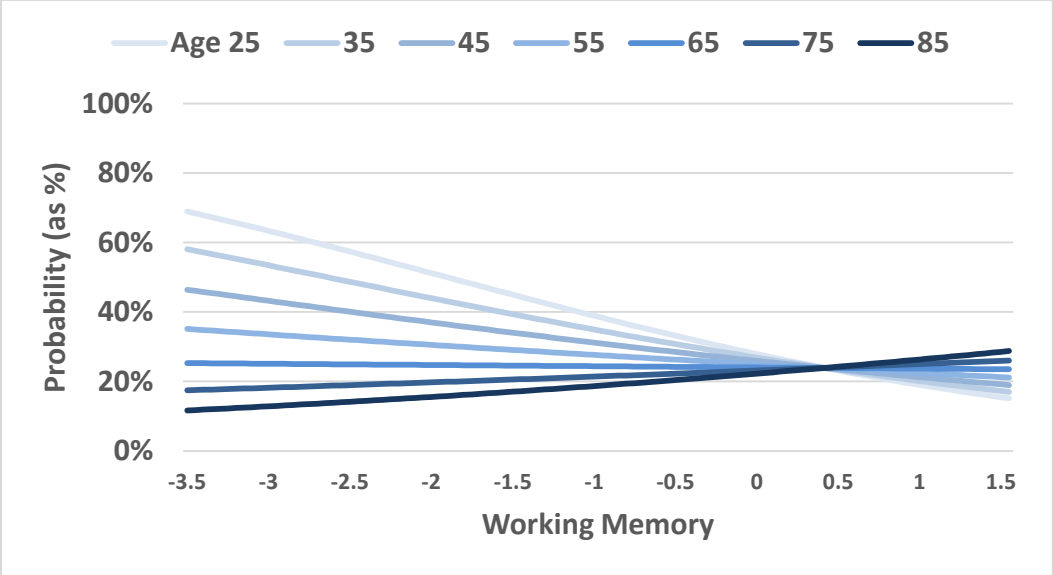
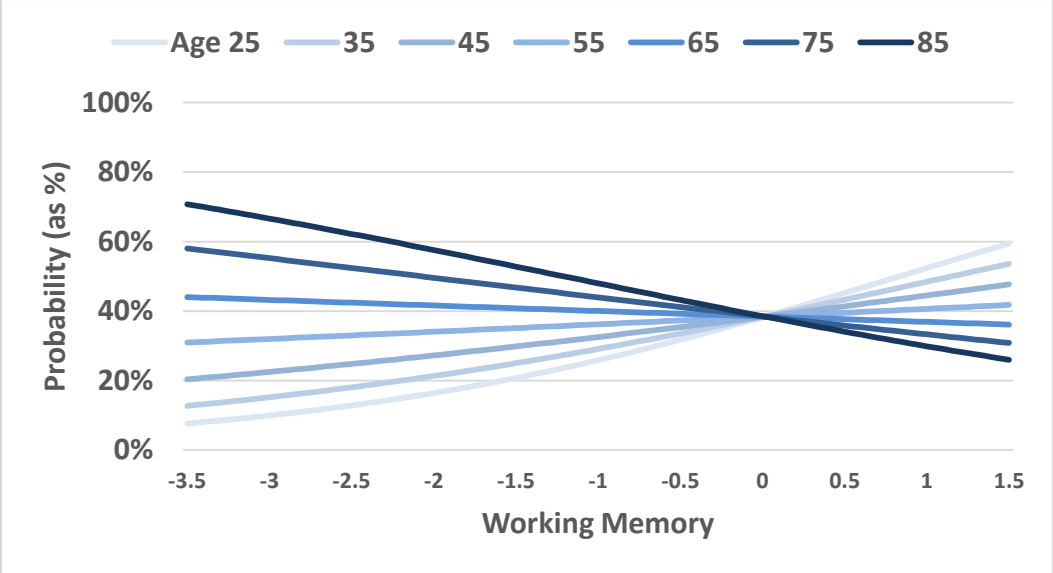


Figure 3.7: Estimated Probability Predicting Late Response Option (Q4-Q6) - Web



After examining the modes separately, the data were combined to assess the impact of mode and its interaction with age and working memory. First, analyses examined the likelihood of selecting an early response across five models. Model 1 includes the three predictors and two control variables. Models 2-4 includes one of the bivariate interactions of age*working memory, age*mode, and working memory*mode. Model 5 combines all variables and interactions including the three-way interaction of age*working memory*mode. Multilevel models are used to account for the repeated measures within respondents, the amount a variance attributed to the respondents is marginally significant ($p<.10$). Combining all interactions in the same model shows a marginally significant two-way interaction between working memory and mode ($\hat{\beta}_{07}$=-0.795, SE=0.470, p=.0911), see Table 3.10. The results also indicate significant differences between the questions, and although not shown, the questions were analyzed separately with the interactions remaining significant in Q4 and Q6.

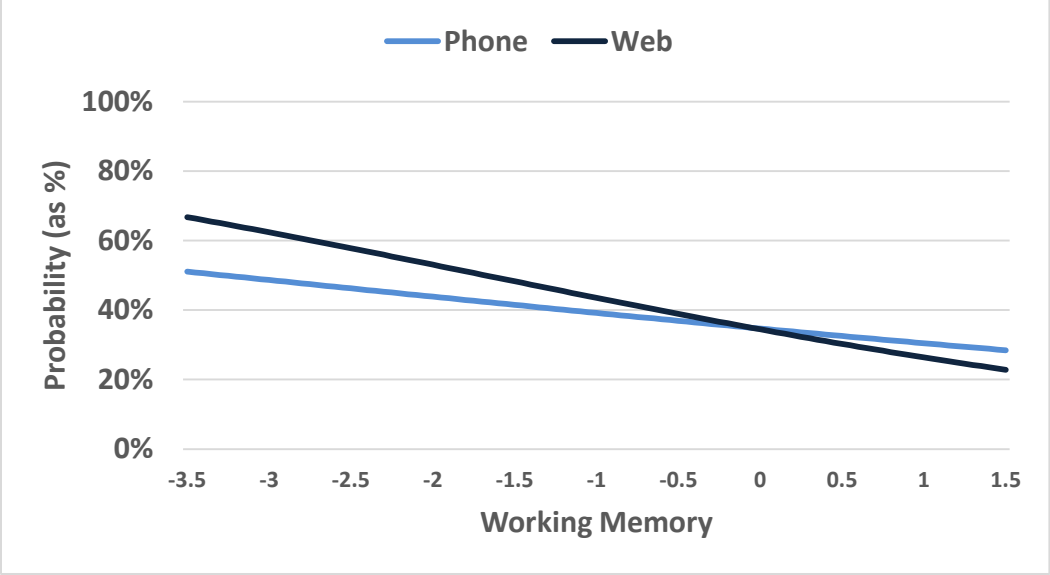
Table 3.10: Multilevel Logistic Regression – Predicting the Probability of Selecting an Early Response Option (Across Q4-Q6) – Combined Modes

	Model 1			Model 2			Model 3			Model 4			Model 5		
	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE
Intercept	-0.749	*	0.297	-0.743	*	0.297	-0.779	*	0.335	-0.759	*	0.298	-0.856	*	0.340
Controls															
Question Number:															
(Ref) Q4	--		--	--		--	--		--	--		--	--		--
Q5	0.347	**	0.129	0.350	**	0.129	0.347	**	0.129	0.349	**	0.129	0.354	**	0.129
Q6	0.250	*	0.127	0.251	*	0.127	0.250	*	0.127	0.250	*	0.127	0.252	*	0.127
Education:															
(Ref) ≤ H.S. grad	--		--	--		--	--		--	--		--	--		--
Tech/Trade/Assoc.'s	0.091		0.205	0.096		0.205	0.089		0.205	0.083		0.205	0.069		0.206
Some college	-0.044		0.231	-0.047		0.231	-0.045		0.231	-0.075		0.232	-0.110		0.233
Bachelor's degree	-0.002		0.200	-0.014		0.200	-0.004		0.200	-0.022		0.200	-0.025		0.202
Post grad degree	-0.048		0.201	-0.032		0.202	-0.049		0.202	-0.076		0.202	-0.069		0.203
Predictors															
Age	-0.002		0.004	-0.002		0.004	-0.002		0.005	-0.002		0.004	-0.000		0.005
Working Memory	-0.023		0.059	-0.274		0.230	-0.022		0.060	0.044		0.078	0.082		0.300
Mode:															
(Ref) Telephone	--		--	--		--	--		--	--		--	--		--
Web	-0.052		0.110	-0.067		0.111	0.027		0.416	-0.046		0.110	0.219		0.434
Interactions															
Age*WM				0.004		0.004							-0.005		0.005
(Ref) Age*Phone							--		--				--		--
Age*Web							-0.001		0.007				-0.004		0.008
(Ref) WM*Phone										--		--	--		--
WM*Web										-0.156		0.114	-0.795	+	0.470
(Ref)Age*WM*Phone													--		--
Age*WM*Web													0.011		0.008
Respondent Variance	0.1508	+	0.100	0.152	+	0.100	0.154	+	0.100	0.149	+	0.100	0.151	+	0.101
-2 Res.Log Likelihood		7458.94			7469.92						7464.45			7495.06	
Generalized X^2		1633.52			1633.07						1634.82			1635.30	

+p<.10, *p<.05, **p<.01; Observations=1710

Figure 3.8 shows in both modes a downward trend reflecting that as working memory improves the probability of selecting an early response declines. For the telephone mode, it is expected that an improvement in working memory would help respondents to select the early responses by not being as susceptible to recency effects, however, the results are contrary to such expectation. In the web mode, the expectation is that as working memory improves, respondents would be less likely to select one of the early options, implying they expend more attention across all of the response options to select one not presented early in the list. Although the overall trend is not what is expected for telephone across working memory, in comparison to web the results do provide support for the expectations of improved working memory benefiting respondents. Respondents with lower working memory are more likely to select an early response in web compared to telephone while respondents at the higher end of working memory are more likely to select an early response in telephone compared to web.

Figure 3.8: Estimated Probability Predicting Early Response Option (Q4-Q6) Model 5 – Mode Interaction



Lastly, the data are analyzed across both modes predicting the selection of a late response. The results in Table 3.11 indicate both a significant three-way interaction between age, working memory, and mode as well as a significant two-way interaction between working memory and mode. The expectation for the telephone mode is that as working memory improves, respondents would be less likely to select one of the later responses. Figure 3.9 shows for the younger respondents they are slightly less likely to select a late response as working memory improves, however there is very little difference for the older respondents. For the web respondents, it is expected that an improvement in working memory would increase the likelihood of respondents selecting a later response. Again, similar to the results with two response options, Figure 3.10 shows there is an increase for the respondents under the age of 65, however, for the older respondents 65+ there is an opposite effect such that a higher working memory results in a lower probability of selecting a later response option.

Table 3.11: Multilevel Logistic Regression – Predicting the Probability of Selecting a Late Response Option (Across Q4-Q6) – Combined Modes

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Intercept	-0.487	0.292	-0.495	0.292	-0.502	0.330	-0.483	0.292	-0.465	0.333
Controls										
Question Number:										
(Ref) Q4	--	--	--	--	--	--	--	--	--	--
Q5	-0.189	0.126	-0.191	0.126	-0.189	0.126	-0.189	0.126	-0.196	0.127
Q6	-0.121	0.122	-0.122	0.123	-0.121	0.123	-0.121	0.123	-0.125	0.123
Education:										
(Ref) ≤ H.S. grad	--	--	--	--	--	--	--	--	--	--
Tech/Trade/Assoc.'s	-0.016	0.203	-0.021	0.203	-0.017	0.203	-0.013	0.203	0.005	0.204
Some college	-0.165	0.229	-0.163	0.229	-0.166	0.2296	-0.152	0.230	-0.109	0.231
Bachelor's degree	0.058	0.196	0.046	0.1967	0.057	0.197	0.067	0.197	0.071	0.199
Post grad degree	0.084	0.197	0.071	0.198	0.084	0.198	0.096	0.199	0.088	0.200
Predictors										
Age	-0.001	0.002	-0.001	0.004	-0.001	0.005	-0.001	0.004	-0.001	0.005
Working Memory	0.007	0.0058	0.199	0.225	0.008	0.059	-0.021	0.076	-0.232	0.296
Mode:										
(Ref) Telephone	--	--	--	--	--	--	--	--	--	--
Web	0.003	0.108	0.013	0.109	0.042	0.409	0.001	0.108	-0.121	0.429
Interactions										
Age*WM			-0.003	0.003					0.003	0.005
(Ref) Age*Phone					--	--			--	--
Age*Web					-0.001	0.007			0.001	0.007
(Ref) WM*Phone							--	--	--	--
WM*Web							0.067	0.113	1.077 *	0.466
(Ref)Age*WM*Phone									--	--
Age*WM*Web									-0.017 *	0.007
Respondent Variance	0.137 +	0.096	0.139 +	0.097	0.140 +	0.097	0.139 +	0.097	0.138 +	0.097
-2 Res.Log Likelihood	7412.57		7422.96		7420.70		7415.53		7447.869	
Generalized X^2	1643.32		1642.32		1642.17		1642.52		1642.20	

+p<.10, *p<.05, **p<.01; Observations=1710

Figure 3.9: Estimated Probability Predicting a Late Response Option (Q4-Q6) Model 5 – Telephone

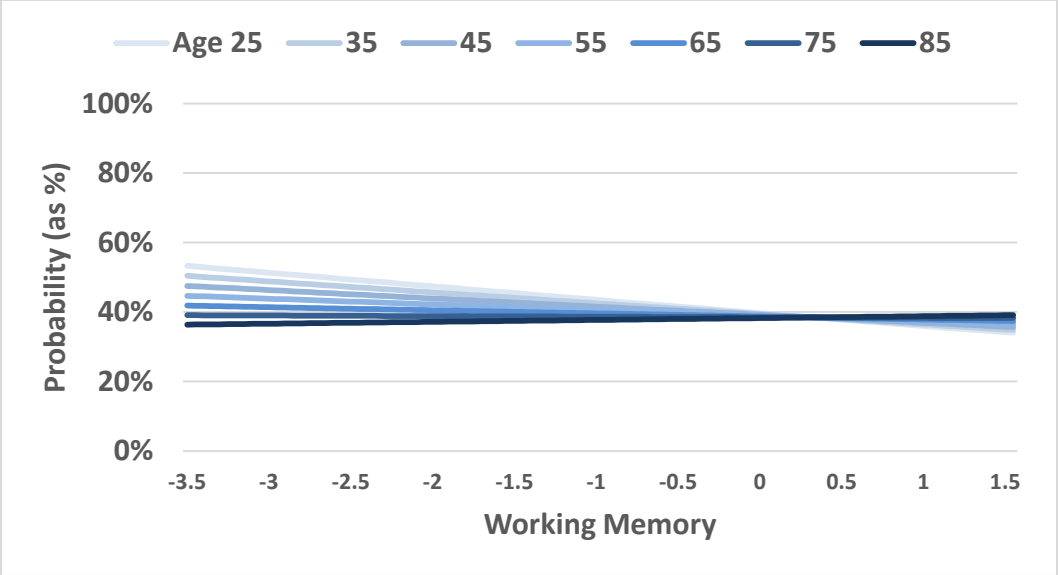
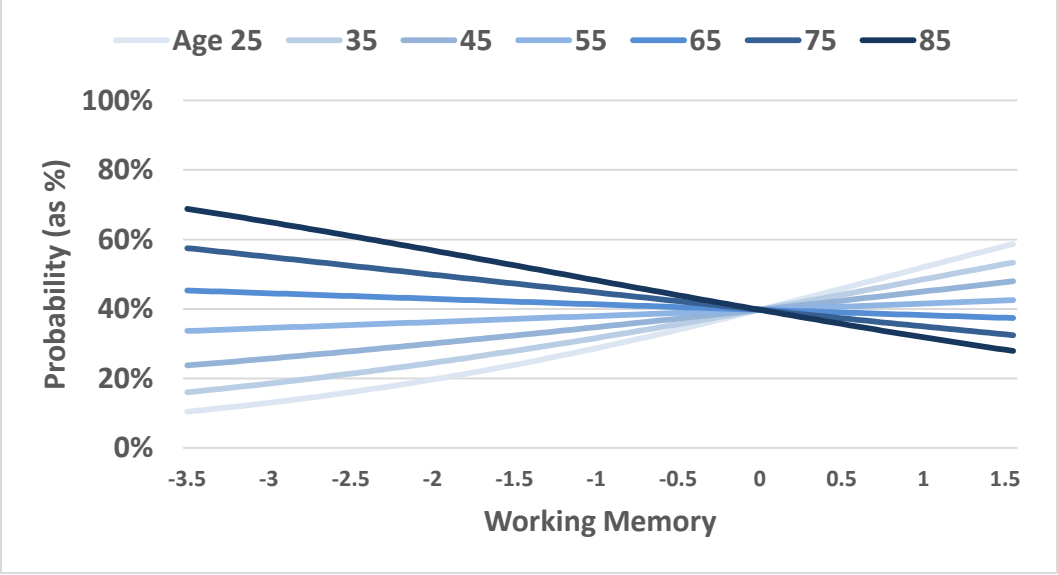


Figure 3.10: Estimated Probability Predicting a Late Response Option (Q4-Q6) Model 5 – Web



3.4 Response Order Effects – Discussion

The results in the previous sections indicate that working memory capacity does influence the response selection of survey respondents. In both the dichotomous and long list of response options, when the modes are combined the results show a significant three-way interaction between age, working memory, and mode. In addition to the three-way interaction, with only two response options present, there was also a significant two-way interaction between age and mode, while with the longer list questions it was the interaction between working memory and mode that was significant.

It was expected that an increase in working memory would decrease respondents' likelihood of selecting the first and last options in web and telephone modes, respectively. This "help" from working memory was anticipated to be consistent across respondents from all ages. For the most part, the results support the expectations for respondents under the age of 65 but not for respondents ages 65 and olderer. There is evidence among the younger respondents that those with lower working memory are more susceptible to response order effects and as working memory improves they become less susceptible. Thus, in the telephone mode as working memory improves younger respondents are less likely to select a late response and are less likely to select an early response in the web mode. Surprisingly among the older adults, the results are contrary to expectations as the findings show an improvement in working memory hurts rather than helps respondents by increasing the likelihood of selecting the primacy and recency option in the respective modes. The findings indicate for older respondents, as working memory improves, there in an increase in the likelihood of selecting a late response in telephone and early response in web. At this time, it is unclear why the

results for older adults, 65+, do not fall in line with the proposed hypotheses. Further studies into the impact of working memory on response order effects may be able to overcome the shortcomings of this study to shed light onto why the current results are showing effects contrary to expectations for adults 65 and older regarding working memory's influence on response order effects.

CHAPTER 4: QUESTION ORDER EFFECTS

4.1 Overall Question Order Effects

The focus of this chapter is to assess whether working memory has an impact on question order effects by influencing the expressed opinion of respondents on the second of two related questions. As discussed in Chapter 2, three pairs of questions were used from previous question order effects studies (Knäuper et al., 2007; Schuman and Presser,1981). Before examining the effects of working memory, each of the three pairs of questions included in the survey were first analyzed for overall question order effects. For general-specific (or part-whole) questions there is an expectation that presenting the specific question first should produce a contrast effect on the response to the general question, however, presenting the general question first is expected to have no effect on the specific question (Schuman & Presser, 1981). Questions that are considered part-part may result in consistency[4] effects where the first question establishes a norm such that respondents are inclined to answer the second question to be consistent with how they answered the first question (Schuman & Presser, 1981). When a consistency effect occurs, endorsement rates to both questions are consistently lower in one order compared to the other order.

The first set of questions asked respondents about their happiness overall and happiness with an intimate partner. This set of questions is considered a general-specific pair where one question (intimate partner) is a subset of the other question (altogether). Respondents were allowed the option to select "no intimate partner" resulting in a smaller

[4] Consistency effects are also referred to as assimilation effects, occuring when information from a preceding question in included in the response formation for a related question (Sudman, Bradburn, & Schwarz, 1996).

analytical sample of 433 respondents who answered both the happiness altogether and happiness with intimate partner questions (telephone=273, web=270). Small cell sizes for the option "not too happy" initially produced invalid Chi-square tests, therefore the category was combined with "somewhat happy". Regarding happiness overall, there is no significant difference in the endorsement rates for very happy and somewhat/not too happy in both the telephone and web modes, see Table 4.1. When asked about their happiness with an intimate partner, there is no difference in the telephone regardless of whether the question was asked first or second. The difference between endorsements is marginally significant in the web survey ($X^2_{(1)}=3.0882$ *df=1, p=0.0789*) where respondents selected they were very happy 72.2% of the time when asked first about happiness with their intimate partner and only 60.8% of the time when asked second. However, these results are contrary to expectations for general-specific questions in which presenting the specific question first tends to produce differences for the endorsement rates for the general question but no difference for the specific question.

Table 4.1: Chi Square Test of Independence – Happiness Questions

	Telephone			
	Altogether		Partner	
Happiness	First	Second	First	Second
Very	75 (56.0%)	76 (54.7%)	113 (81.3%)	103 (76.9%)
Somewhat/Not too	59 (44.0%)	63 (45.3%)	26 (18.7%)	31 (23.1%)
Total	134	139	139	134
	X^2=0.0462, df=1, p=0.8298		*X^2=0.8103, df=1, p=0.3680*	
	Web			
	Altogether		Partner	
Happiness	First	Second	First	Second
Very	46 (45.1%)	45 (41.7%)	78 (72.2%)	62 (60.8%)
Somewhat/Not too	56 (54.9%)	63 (58.3%)	30 (27.8%)	40 (39.2%)
Total	102	108	108	102
	X^2=0.2515, df=1, p=0.6160		*X^2=3.0882, df=1, p=0.0789*	

Table 4.2 shows for each mode the two-by-two contingency tables, including correlations, of the answers (very happy vs. somewhat/not too happy) to each question for each presentation order. Because the data are dichotomous, the correlations are reported as phi coefficients (r_ϕ). The correlation of the answers is lower when the specific question with an intimate partner is asked first (r_ϕ=0.1933) compared to the correlation of the answers when the happiness altogether question is asked first (r_ϕ=0.3690), comparing the correlations with a Fisher's r-to-z transformation test show a marginal significance at p=.06 (z=1.56). A lower correlation in the specific question indicates a contrast effect where information retrieved for the first, specific question is excluded when forming the response to the second, general question. This contrast effect is in line with the expectations of general-specific questions. The contrast effect demonstrates that when the partner (specific) is asked first the information retrieved during the process of answering the partner question is then removed from the information respondents use when answering the question of happiness overall (general) resulting in a lower correlation between the questions.

Table 4.2: Phi Correlations by Mode – Happiness Questions

Telephone					
Altogether First			Partner First		
	Partner			*Partner*	
Altogether	Very	Somewhat/Not	*Altogether*	Very	Somewhat/Not
Very	68 (50.8%)	7 (5.2%)	Very	67 (48.2%)	9 (6.5%)
Somewhat/Not	35 (26.1%)	24 (17.9%)	Somewhat/Not	46 (33.1%)	17 (12.2%)
	n=134, r_ϕ=0.3690			n=139, r_ϕ=0.1933	
Web					
Altogether First			Partner First		
	Partner			*Partner*	
Altogether	Very	Somewhat/Not	*Altogether*	Very	Somewhat/Not
Very	39 (38.2%)	7 (6.9%)	Very	43 (39.8%)	2 (1.9%)
Somewhat/Not	23 (22.6%)	33 (32.4%)	Somewhat/Not	35 (32.4%)	28 (25.9%)
	n=102, r_ϕ=0.4455			n=108, r_ϕ=0.4403	

The next pair of questions asked respondents about the rights of laborers and unions to strike preceded or followed by a question on the rights of business owners to shutdown factories or stores. These questions are considered to be part-part, meaning that both questions are viewed as being under a larger general category rather than the topic of one question being a subset of the other. In the case of part-part questions, question order effects are not expected from a particular order but may occur from either order of presentation. Often the first question can establish a norm for both questions, resulting in endorsement rates for one presentation order to be lower in both questions compared to the reverse presentation order. With this set of questions, there was some item non-response resulting in a total of 514 respondents who answered both of the labor questions (telephone=291, web=223).

For the right to strike question there is a significant relationship ($X^2_{(1)}=11.8193$, $df=1$, $p=0.0006$) between the order in which the question is presented and the endorsement rates of the respondents, in the telephone mode only. For instance, when the right to strike question is asked first 71.5% select yes while the endorsement climbs to 87.7% when the question is asked second, as shown in Table 4.3. When respondents are asked about the right to shutdown businesses, there is a marginally significant relationship ($X^2_{(1)}=3.1283$, $df=1$, $p=0.0769$) between question order and endorsement rates in the web mode only. Respondents in the web mode endorsed a business owners' rights by 81.6% when the question was presented first, but the endorsement decreased to 71.6% when the question was presented second.

Table 4.3: Chi Square Test of Independence – Labor Questions

	Telephone			
	Labor Strike		Factory/Store Shutdown	
Endorsement	First	Second	First	Second
Yes	98 (71.5%)	135 (87.7%)	111 (72.1%)	99 (72.3%)
No	39 (28.5%)	19 (12.3%)	43 (27.9%)	38 (27.7%)
Total	137	154	154	137
	X^2=11.8193 df=1, p=0.0006		*X^2=0.0012 df=1, p=0.9720*	
	Web			
	Labor Strike		Factory/Store Shutdown	
Endorsement	First	Second	First	Second
Yes	83 (76.2%)	90 (79.0%)	93 (81.6%)	78 (71.6%)
No	26 (23.9%)	24 (21.1%)	21 (18.4%)	31 (28.4%)
Total	109	114	114	109
	X^2=0.2513, df=1, p=0.6162		*X^2=3.1283, df=1, p=0.0769*	

Looking at the endorsements from a consistency effects perspective, it does appear in the web mode that whichever question is asked first establishes a norm for the respondents. Thus, when respondents are asked the shutdown question first the endorsement rates for both questions are higher (81.6% and 79.0% for shutdown and strike, respectively) compared to the endorsement rates when the strike question is asked first (71.6% and 76.2% for shutdown and strike respectively). Such consistency effect is not present for the telephone mode as approximately 72% of respondents endorse employers' right to shutdown regardless of whether the question is presented first or second.

The third pair of questions involved opinions on abortion, asking whether abortion should possible for a woman who is married and no longer wants children compared to whether an abortion should be possible if there is a strong chance the baby will have a birth defect. It is unclear whether respondents will interpret these questions as general-specific or part-part. In the early 1980's when Schuman and Presser administered this question they did so under the assumption that the question about the

married woman was a general question and the birth defect question more specific. However, rather than asking about any woman in general, the married question does propose a specific scenario which may be interpreted as another specific instance rather than a generalization of all women and scenarios of abortion. As this topic is sensitive in nature there was item non-response where some respondents chose not to answer at least one of the questions resulting in 499 respondents who answered both questions regarding their views on abortion (telephone=287, web=212).

Results from the chi-square test in the telephone mode indicate there were no differences in the rates of endorsement in either question regardless of the order presented. For respondents in the web mode, there is a significant relationship between the endorsement rates and question order for both the question on possibility of birth defect ($X^2_{(1)}=6.5899, df=1, p=0.0103$) and the question for a married woman wanting no more children ($X^2_{(1)}=14.8135, df=1, p=0.0001$). For the birth defect question, the endorsement of yes increases from 60.0% when asked first to 76.5% when asked second, while the endorsement of yes decreases for the married question from 63.7% when asked first to 37.3% when asked second. The results are shown in Table 4.4.

Table 4.4: Chi Square Test of Independence – Abortion Questions

	Telephone			
	Married		Birth Defect	
Endorsement	First	Second	First	Second
Yes	71 (53.4%)	72 (46.8%)	106 (68.8%)	85 (63.9%)
No	62 (46.6%)	82 (52.3%)	48 (31.2%)	48 (36.1%)
Total	133	154	154	133
	X^2=1.2549, df=1, p=0.2626		*X^2=0.7765, df=1, p=0.3782*	
	Web			
	Married		Birth Defect	
Endorsement	First	Second	First	Second
Yes	65 (63.7%)	41 (37.3%)	66 (60.0%)	78 (76.5%)
No	37 (36.3%)	69 (62.7%)	44 (40%)	24 (23.5%)
Total	102	110	110	102
	X^2=14.8135, df=1, p=0.0001		*X^2=6.5899, df=1, p=0.0103*	

Although there is evidence of question order effects in the web mode, the evidence is contradictory as to whether respondents view the questions as general-specific or part-part. First, there appears to be consistency effects such that when the married question is asked first the endorsement rates of both questions are higher (63.7% & 76.5% for married and defect, respectively) compared to the endorsement rates when the birth defect question is asked first (37.3% & 60.0% for married and defect, respectively), as shown in Table 4.4. The consistency effect indicates that respondents try to align their responses based on the norm that is established in the first question. There is also some evidence of contrast effects as well from the correlations, such that the correlation (phi) coefficient decreases (z=1.58, p=.06) when the defect question is asked first. As shown in Table 4.5, the correlations for web mode decrease from r_ϕ=0.6871 to r_ϕ=0.5526 for married first and defect first, respectively. The contrast effect indicates when defect is asked first respondents exclude their views for the birth defect scenario when formulating their opinion for the scenario of a woman being married and wanting

no more children. Another view of the contrast effects could be that respondents who encounter the defect question first establish it as a standard of comparison for subsequent abortion questions, leading to a comparison-based contrast effect (Sudman, Bradburn, & Schwarz, 1996). Thus, it is still unclear how respondents interpret the relationship between the two abortion questions, with some apparently treating the questions as a part-part relationship and others as a part-whole relationship. As a note, the survey was administered in one politically conservative state only, and the question order results, in particular for the abortion questions, may not be generalizable to residents in more politically liberal states.

Figure 4.5: Phi Correlations by Mode – Abortion Questions

Telephone

Married First			Defect First		
	Defect			*Defect*	
Married	Yes	No	*Married*	Yes	No
Yes	66 (49.6%)	5 (3.8%)	Yes	71 (46.1%)	1 (0.7%)
No	19 (14.3%)	43 (32.3%)	No	35 (22.7%)	47 (30.5%)
	n = 133, r_ϕ=0.6472			n = 154, r_ϕ=0.6025	

Web

Married First			Defect First		
	Defect			*Defect*	
Married	Yes	No	*Married*	Yes	No
Yes	64 (62.8%)	1 (1.0%)	Yes	39 (35.5%)	2 (1.8%)
No	14 (13.7%)	23 (22.6%)	No	27 (25.6%)	42 (38.2%)
	n = 102, r_ϕ=0.6871			n = 110, r_ϕ=0.5526	

Overall, the results of this section support previous question order effects findings by indicating that the opinion provided by respondents to the second of two related questions is sometimes influenced by the order in which the questions are presented. The next step is to assess whether working memory plays a role in influencing the endorsement rates of the second question. In particular, testing to see if there is an

interaction between respondents' answers to the first questions and their working memory capacity.

4.2 Assessing the Impact of Working Memory on Question Order Effects

Similar to the earlier analyses on response order effects, next, the pairs of questions are analyzed to determine if respondents are influenced by their working memory capacity in the answers they provide to related questions. It is expected that respondents with higher working memory capacity will be more influenced than those with lower working memory capacity. When two related questions are asked close together, respondents with higher working memory capacity may be more likely to remember the information retrieved to formulate their first response and remembering such information may impact their response to the second question. Inversely, respondents with low working memory capacity are less likely to remember the information retrieved for the first question, therefore, the answer to the second question is more likely to be independent of the first question.

To assess the impact of working memory, logistic regression will be used to predict the positive response options (i.e., very happy, yes) to the second question using the predictors of age, working memory, first question response, and their interactions, while controlling for education. Within each mode there are five models for each question, the first containing the individual predictors only, next including the two-way interactions one at a time, and finally a model combining the predictors and all interactions including the three-way interaction of age*working memory*question order. In addition to the logistic regression models, the correlations will be examined at different levels of working memory for the contrast effects from the previous section for

the happiness and abortion questions. The expectation is for there to be a stronger contrast effect for respondents with higher working memory capacity compared to respondents with lower working memory capacity.

For the happiness questions, the models indicate there is no working memory impact. Primarily the results, shown in Tables 4.6-4.9, point towards the answer to the previous question as being the only significant indicator of whether respondents will answer very happy to the second question. These model results hold for predicting a very happy response to both happiness questions when they are presented second. Comparing the correlations of the responses for respondents with high and low working memory capacity (using a mean[5] split), there is no difference in correlations in the web mode for both high (partner first, r_ϕ=0.4201; altogether first, r_ϕ=0.4586) and low (partner first, r_ϕ=0.4801; altogether first, r_ϕ=0.4116) groups, consistent with the overall findings from the previous section. For the telephone mode, there is no significant difference in the correlations for the low working memory capacity group when the partner is asked first (r_ϕ=0.1208) compared to when the altogether question is asked first (r_ϕ=0.3228). However, for the high working memory capacity group the correlation of responses when partner is asked first (r_ϕ=0.2208) is lower than the correlation of responses when the happiness altogether question is asked first (r_ϕ=0.4085) at a marginally significant level (z=1.32, p=.09). This larger contrast effect for the higher working memory capacity group indicates that respondents who have a better working memory are more likely to be

[5] A mean split was used to provide larger cell sizes, a median split resulted in too many cell counts less than five.

influenced in answering the altogether question by partner question when it is asked first, in the telephone mode, compared to respondents with poorer working memory capacity.

Table 4.6: Logistic Regression – Predicting the Probability of Selecting Very Happy to "Happiness Altogether" when Asked Second – Telephone[6]

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Intercept	0.111	0.966	0.147	0.880	0.515	1.033	0.119	0.967	0.588	1.049
Education:										
(Ref) ≤ H.S. grad	--	--	--	--	--	--	--	--	--	--
Tech/Trade/Assoc.'s	0.457	0.726	0.468	0.729	0.399	0.729	0.484	0.732	0.483	0.740
Some college	0.486	0.951	0.500	0.954	0.460	0.951	0.528	0.962	0.528	0.966
Bachelor's degree	0.578	0.688	0.593	0.692	0.513	0.691	0.597	0.692	0.549	0.698
Post grad degree	0.890	0.699	0.899	0.701	0.864	0.700	0.918	0.706	0.935	0.711
Age	-0.006	0.013	-0.007	0.013	-0.013	0.014	-0.007	0.012	-0.015	0.014
Working Memory	0.178	0.222	-0.017	0.826	0.149	0.224	0.150	0.240	-0.011	0.884
1st Question Answer:										
(Ref) Yes	--	--	--	--	--	--	--	--	--	--
No	-1.049 *	0.465	-1.066 *	0.470	-3.229	2.036	-1.090 *	0.488	-3.227	2.278
Age*WM			0.003	0.012					0.002	0.013
(Ref) Age*1st Yes					--	--			--	--
Age*1st No					0.038	0.034			0.038	0.037
(Ref) WM*1st Yes							--	--	--	--
WM*1st No							0.175	0.586	-0.989	3.418
(Ref)Age*WM*1st Yes									--	--
Age*WM*1st No									0.021	0.054
AICC	198.22		200.45		199.19		200.42		205.73	
BIC	220.59		225.46		224.21		225.43		238.47	

*p<.05
Observations =139

[6] The models in this chapter use the standardized working memory scores. Regarding the happiness questions the only change in significant effects is to Model 4, across both questions and both modes (see also Tables 4.7-4.9), question order changes led to non-significant results with the raw scores.

Table 4.7: Logistic Regression – Predicting the Probability of Selecting Very Happy to "Happiness Altogether" when Asked Second – Web

	Model 1			Model 2			Model 3		Model 4			Model 5	
	Coef.		SE	Coef.		SE	Coef.	SE	Coef.		SE	Coef.	SE
Intercept	0.537		1.313	0.432		1.324	0.147	1.365	0.523		1.310	0.012	1.391
Education:													
(Ref) ≤ H.S. grad	--		--	--		--	--	--	--		--	--	--
Tech/Trade/Assoc.'s	-0.508		0.968	-0.561		0.976	-0.504	0.990	-0.500		0.964	-0.578	1.000
Some college	-0.576		1.047	-0.606		1.053	-0.589	1.067	-0.544		1.045	-0.589	1.083
Bachelor's degree	-0.693		0.925	-0.731		0.932	-0.637	0.948	-0.710		0.919	-0.686	0.955
Post grad degree	-0.687		0.929	-0.729		0.935	-0.613	0.954	-0.662		0.927	-0.645	0.959
Age	0.005		0.016	0.007		0.016	0.012	0.016	0.005		0.016	0.015	0.017
Working Memory	-0.091		0.235	0.598		1.025	-0.111	0.242	-0.142		0.252	0.601	1.134
1st Question Answer:													
(Ref) Yes	--		--	--		--	--	--	--		--	--	--
No	-2.847	***	0.781	-2.879	***	0.785	1.656	3.022	2.914	***	0.827	1.408	3.260
Age*WM				-0.012		0.017						-0.013	0.020
(Ref) Age*1st Yes							--	--				--	--
Age*1st No							-0.100	0.073				-0.095	0.076
(Ref) WM*1st Yes									--		--	--	--
WM*1st No									0.586		0.960	0.128	3.235
(Ref)Age*WM*1st Yes												--	--
Age*WM*1st No												0.0002	0.070
AICC	138.27			140.17			138.24		140.20			145.09	
BIC	158.27			162.48			160.54		162.50			173.99	

***p<.001
Observations =108

Table 4.8: Logistic Regression – Predicting the Probability of Selecting Very Happy to "Happiness with Intimate Partner" when Asked Second – Telephone

	Model 1			Model 2			Model 3			Model 4			Model 5		
	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE
Intercept	1.490		1.118	1.536		1.133	2.102		1.672	1.576		1.148	2.4374		1.921
Education:															
(Ref) ≤ H.S. grad	--		--	--		--	--		--	--		--	--		--
Tech/Trade/Assoc.'s	0.617		0.780	0.607		0.782	0.645		0.780	0.627		0.795	0.641		0.795
Some college	0.469		0.862	0.473		0.865	0.487		0.865	0.434		0.875	0.496		0.879
Bachelor's degree	2.071	*	0.896	2.100	*	0.902	2.074	*	0.895	2.073	*	0.904	2.130	*	0.915
Post grad degree	0.740		0.847	0.747		0.849	0.726		0.843	0.713		0.858	0.640		0.861
Age	-0.001		0.015	-0.002		0.015	-0.013		0.027	0.0003		0.015	-0.016		0.031
Working Memory	-0.298		0.295	-0.603		1.073	-0.287		0.292	-0.683		0.537	-0.639		1.860
1st Question Answer:															
(Ref) Yes	--		--	--		--	--		--	--		--	--		--
No	-1.830	***	0.497	-1.825	***	0.498	-2.727		1.840	-2.023	***	0.570	-3.184		2.116
Age*WM				0.005		0.017							-0.001		0.031
(Ref) Age*1st Yes							--		--				--		--
Age*1st No							0.017		0.032				0.022		0.036
(Ref) WM*1st Yes										--		--	--		--
WM*1st No										0.575		0.618	-0.147		2.399
(Ref)Age*WM*1st Yes													--		--
Age*WM*1st No													0.013		0.738
AICC	134.36			136.57			136.39			135.72			142.12		
BIC	156.39			161.20			161.02			160.35			174.32		

*p<.05, ***p<.001
Observations = 134

Table 4.9: Logistic Regression – Predicting the Probability of Selecting Very Happy to "Happiness with Intimate Partner" when Asked Second – Web

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Intercept	1.464	1.387	1.488	1.416	1.407	1.797	1.713	1.461	1.445	2.226
Education:										
(Ref) ≤ H.S. grad	--	--	--	--	--	--	--	--	--	--
Tech/Trade/Assoc.'s	-0.992	0.970	-1.012	1.022	-0.993	0.970	-1.054	0.978	-1.078	1.013
Some college	-0.286	0.994	-0.315	1.058	-0.292	1.000	-0.446	1.041	-0.473	1.096
Bachelor's degree	-0.645	0.918	-0.653	0.924	-0.644	0.918	-0.691	0.924	-0.701	0.932
Post grad degree	-1.202	0.929	-1.213	0.940	-1.203	0.930	-1.265	0.939	-1.299	0.957
Age	0.021	0.020	0.021	0.020	0.022	0.031	0.019	0.020	0.025	0.039
Working Memory	0.063	0.282	-0.068	1.282	0.063	0.282	-0.308	0.737	0.415	0.288
1st Question Answer:										
(Ref) Yes	--	--	--	--	--	--	--	--	--	--
No	-2.257 ****	0.540	-2.260 ****	0.542	-2.151	2.201	-2.348 ***	0.579	-2.112	2.530
Age*WM			0.002	0.022					-0.014	0.056
(Ref) Age*1st Yes					--	--			--	--
Age*1st No					-0.002	0.041			-0.005	0.047
(Ref) WM*1st Yes							--	--	--	--
WM*1st No							0.439	0.798	-0.465	3.208
(Ref)Age*WM*1st Yes									--	--
Age*WM*1st No									0.018	0.061
AICC	128.97		131.37		131.38		131.06		138.53	
BIC	148.42		153.04		153.04		152.73		166.52	

***p<.001, ****p<.0001
Observations = 102

Turning to the labor condition questions, the models do indicate that the responses to the second question are, at times, influenced by working memory. Table 4.10 shows the models predicting a yes response to workers' right to strike when it is preceded by employers' right to shutdown. Model 4 indicates that age ($\hat{\beta}_2$=-0.044, SE=0.022, p=.0488), working memory ($\hat{\beta}_3$=-0.725, SE=0.422, p=.0879), and the interaction of working memory and the answer to the employers' right to shutdown ($\hat{\beta}_7$=1.121, SE=0.670, p=.0966) all significantly influence whether respondents indicate yes to workers' right to strike. More cognitive effort is required for contrast effects than for consistency/assimilation effects (Sudman, Bradburn, Schwarz, 1996; Tourangeau, Rips, & Rasinski, 2000). Looking at Figures 4.1 and 4.2, it is the respondents at the lower end of working memory that are more likely to endorse the same answer for workers' right to strike as they endorsed for employers' right to shutdown. Compared to respondents with low working memory capacity, respondents with high working memory capacity are less likely to endorse the same response, therefore more likely to select the contrasting response option. For instance, Figure 4.1 shows respondents who answered yes to employers' right to shutdown are highly likely to say yes to workers' right to strike if they have a low working memory capacity (i.e., consistency), but this likelihood decreases for all respondents as working memory improves (i.e., contrast). Thus, respondents with higher working memory capacity are less likely to endorse the right to strike following an endorsement of the right to shutdown. In contrast, Figure 4.2 shows respondents who answered no to employers' right to strike, are less likely to select yes, the contrast option, when they have low working memory, but the likelihood of selecting the contrasting option increases as working memory improves.

Figure 4.1: Estimated Probability of Selecting Yes to Workers' Right to Strike when Answer Yes to Employers' Right to Shutdown – Telephone

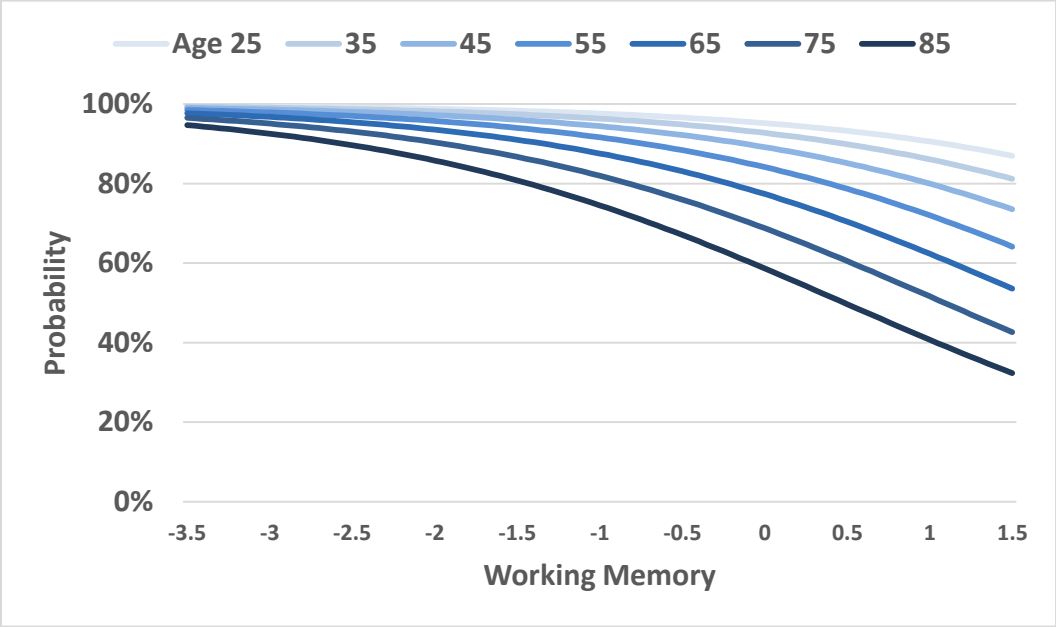
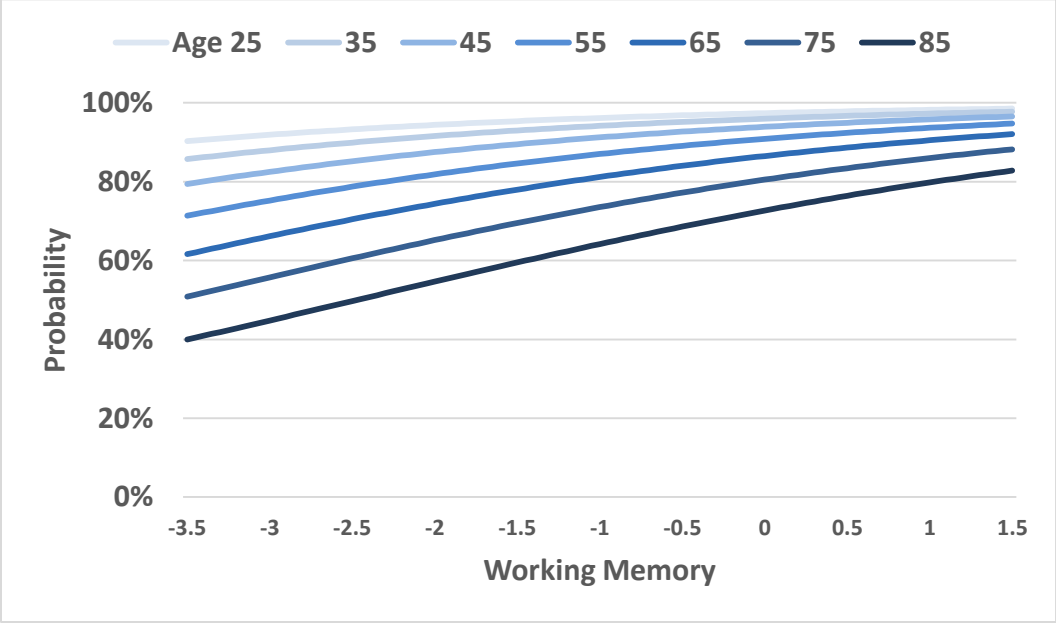
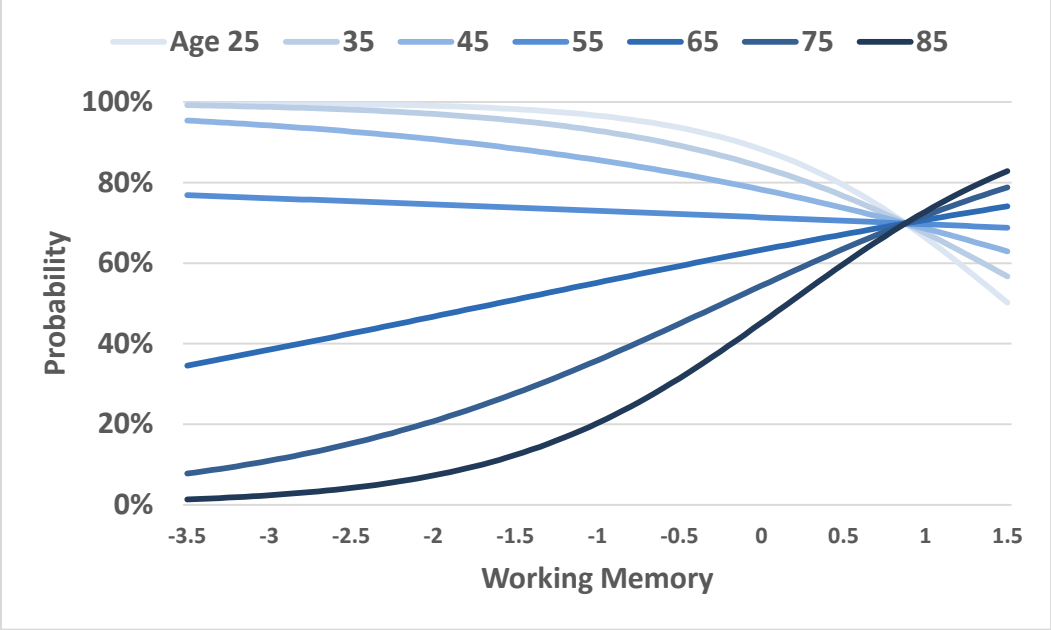


Figure 4.2: Estimated Probability of Selecting Yes to Workers' Right to Strike when Answer No to Employers' Right to Shutdown – Telephone



Focusing next on the web mode, Model 2 in Table 4.11 indicates age ($\hat{\beta}_2$=-0.039, SE=0.021, p=.0597), working memory ($\hat{\beta}_3$=-2.392, SE=1.302, p=0.0689), and their interaction ($\hat{\beta}_5$=0.042, SE=0.020, p=.0398) impact the probability of respondents selecting yes to workers' right to strike. In Figure 4.3, there are clear differences across age and working memory as younger respondents with low working memory capacity are highly likely to respond yes to workers' right when they said yes to employers' right and this likelihood decreases as working memory improves. Contrary to the younger respondents, older respondents with low working memory capacity are very unlikely to select yes to workers' right when they said yes to employers' right and this likelihood increases as working memory improves. It is unclear what factors are contributing to such drastic differences between younger and older respondents with low working memory capacity regarding the likelihood of endorsing the right to strike following an endorsement for the right to shutdown.

Figure 4.3: Estimated Probability of Selecting Yes to Workers' Right to Strike when Answer Yes to Employers' Right to Shutdown – Web



Although there is an influence of working memory on the workers' right to strike question, the results shown in Tables 4.12 & 4.13 show that when employers' right to shutdown is asked second there is no influence from working memory. Similar to the happiness questions, employers' right to strike appears to be primarily influenced by the response to workers' right to strike but this influence is not influenced by working memory.

Table 4.10: Logistic Regression – Predicting the Probability of Selecting Yes to "Workers' Right to Strike" when Asked Second – Phone[7]

	Model 1			Model 2			Model 3			Model 4			Model 5		
	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE
Intercept	3.429	*	1.525	3.238	*	1.586	4.097	*	1.742	4.085	*	1.633	5.640	*	2.313
Education:															
(Ref) ≤ H.S. grad	--		--	--		--	--		--	--		--	--		--
Tech/Trade/Assoc.'s	0.965		0.925	1.007		0.926	0.994		0.931	0.858		0.952	0.892		0.977
Some college	1.135		1.342	1.184		1.340	1.126		1.346	1.242		1.366	1.297		1.395
Bachelor's degree	0.162		0.864	0.200		0.862	0.174		0.871	0.041		0.902	0.021		0.938
Post grad degree	1.037		0.922	1.077		0.920	1.016		0.924	0.809		0.960	0.722		0.984
Age	-0.037	+	0.021	-0.035		0.021	-0.047	+	0.024	-0.044	*	0.022	-0.067	*	0.031
Working Memory	-0.384		0.342	0.149		1.480	-0.424		0.345	-0.725	+	0.422	-1.207		1.993
1st Question Answer:															
(Ref) Yes	--		--	--		--	--		--	--		--	--		--
No	0.441		0.618	0.484		0.631	-2.152		2.518	0.573		0.701	-4.381		3.000
Age*WM				-0.008		0.022							0.004		0.028
(Ref) Age*1st Yes							--		--				--		--
Age*1st No							0.043		0.042				0.083	+	0.049
(Ref) WM*1st Yes										--		--	--		--
WM*1st No										1.121	+	0.670	0.749		3.391
(Ref)Age*WM*1st Yes													--		--
Age*WM*1st No													0.013		0.054
AICC	125.18			127.29			126.41			124.60			128.70		
BIC	148.48			153.38			152.50			150.68			162.93		

+p<.10, *p<.05
Observations = 154

[7] Using the raw working memory scores there are no differences in the significant effects across all five models.

Table 4.11: Logistic Regression – Predicting the Probability of Selecting Yes to "Workers' Right to Strike" when Asked Second – Web[8]

	Model 1			Model 2			Model 3			Model 4			Model 5		
	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE
Intercept	2.383	+	1.381	2.585	+	1.460	2.210		1.410	2.062		1.400	2.155		1.527
Education:															
(Ref) ≤ H.S. grad	--		--	--		--	--		--	--		--	--		--
Tech/Trade/Assoc.'s	1.648	+	0.951	1.747	+	0.957	1.572		0.969	1.472		0.978	1.514		1.026
Some college	1.184		1.004	1.160		1.002	1.090		1.023	1.184		1.030	1.016		1.058
Bachelor's degree	0.313		0.815	0.478		0.808	0.231		0.836	0.316		0.839	0.248		0.861
Post grad degree	1.947	*	0.962	2.439	*	1.042	1.845	+	0.983	1.785	+	0.990	2.206	*	1.092
Age	-0.036	+	0.019	-0.039	+	0.021	-0.032		0.021	-0.029		0.020	-0.027		0.023
Working Memory	0.224		0.235	-2.392	+	1.302	0.238		0.236	0.340		0.246	-2.458	+	1.318
1st Question Answer:															
(Ref) Yes	--		--	--		--	--		--	--		--	--		--
No	-0.146		0.626	-0.319		0.638	1.403		3.037	1.095		1.262	-1.184		3.712
Age*WM				0.042	*	0.020							0.045	*	0.020
(Ref) Age*1st Yes							--		--				--		--
Age*1st No							-0.027		0.051				0.039		0.074
(Ref) WM*1st Yes										--		--	--		--
WM*1st No										-2.611		1.738	5.568		5.528
(Ref)Age*WM*1st Yes													--		--
Age*WM*1st No													-0.139		0.103
AICC	121.89			119.17			123.95			120.68			121.48		
	142.41			142.07			146.85			143.57			151.23		

+p<.10, *p<.05
Observations = 114

[8] Using the raw working memory scores age is significant at p<.05 for Model 2 and Model 4.

Table 4.12: Logistic Regression – Predicting the Probability of Selecting Yes to "Employers' Right to Shutdown" when Asked Second – Phone[9]

	Model 1			Model 2			Model 3			Model 4			Model 5		
	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE
Intercept	1.095		0.956	1.158		0.971	1.422		1.075	1.102		0.958	1.568		1.100
Education:															
(Ref) ≤ H.S. grad	--		--	--		--	--		--	--		--	--		--
Tech/Trade/Assoc.'s	-1.207	+	0.658	-1.233	+	0.663	-1.168	+	0.656	-1.203	+	0.660	-1.149	+	0.663
Some college	-0.586		0.810	-0.604		0.812	-0.567		0.817	-0.580		0.812	-0.507		0.817
Bachelor's degree	0.099		0.689	0.057		0.696	0.195		0.706	0.092		0.690	0.235		0.715
Post grad degree	0.712		0.821	0.677		0.825	0.725		0.824	0.690		0.824	0.629		0.828
Age	0.010		0.013	0.009		0.014	0.002		0.016	0.009		0.013	-0.001		0.017
Working Memory	0.176		0.242	0.528		0.847	0.163		0.242	0.134		0.295	1.044		1.156
1st Question Answer:															
(Ref) Yes	--		--	--		--	--		--	--		--	--		--
No	-1.233	*	0.472	-1.220	*	0.473	-2.300		1.578	-1.224	*	0.474	-2.656		1.641
Age*WM				-0.006		0.014							-0.016		0.018
(Ref) Age*1st Yes							--		--				--		--
Age*1st No							0.019		0.027				0.027		0.028
(Ref) WM*1st Yes										--		--	--		--
WM*1st No										0.116		0.469	-1.341		1.725
(Ref)Age*WM*1st Yes													--		--
Age*WM*1st No													0.027		0.029
AICC	163.57			165.67			165.35			165.80			171.26		
BIC	185.80			190.53			190.21			190.66			203.78		

+p<.10, *p<.05
Observations = 137

[9] Using raw working memory scores, question order is not a significant predictor in Model 4.

Table 4.13: Logistic Regression – Predicting the Probability of Selecting Yes to "Employers' Right to Shutdown" when Asked Second – Web[10]

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Intercept	0.801	1.308	0.605	1.383	0.898	1.368	0.797	1.308	0.681	1.449
Education:										
(Ref) ≤ H.S. grad	--	--	--	--	--	--	--	--	--	--
Tech/Trade/Assoc.'s	-0.281	0.925	-0.079	0.948	-0.267	0.934	-0.281	0.925	-0.067	0.947
Some college	-0.187	0.923	0.143	0.959	-0.128	0.953	-0.182	0.925	0.162	0.875
Bachelor's degree	0.849	0.888	0.769	0.902	0.877	0.895	0.860	0.897	0.817	0.395
Post grad degree	-0.086	0.872	-0.084	0.888	-0.048	0.885	-0.071	0.889	-0.044	0.964
Age	0.004	0.017	0.006	0.018	0.002	0.020	0.004	0.017	0.004	0.021
Working Memory	-0.140	0.259	1.885	1.291	-0.142	0.260	-0.156	0.318	1.063	1.416
1st Question Answer:										
(Ref) Yes	--	--	--	--	--	--	--	--	--	--
No	-0.891 +	0.520	-0.915 +	0.529	-1.423	2.259	-0.894 +	0.520	-1.118	2.073
Age*WM			-0.035	0.022					-0.021	0.024
(Ref) Age*1st Yes					--	--			--	--
Age*1st No					0.009	0.038			0.001	0.045
(Ref) WM*1st Yes							--	--	--	--
WM*1st No							0.050	0.565	4.868	4.389
(Ref)Age*WM*1st Yes									--	--
Age*WM*1st No									-0.081	0.072
AICC	140.18		139.78		142.50		142.55		145.45	
BIC	160.28		162.19		164.91		164.96		174.49	

+p<.10
Observations = 109

[10] Using raw working memory scores, question order is not a significant predictor in Model 4.

For the abortion questions, looking at both the telephone and web modes, when the question regarding a married woman is asked second, there is no influence of working memory on the likelihood a respondent will say yes (see Tables 4.14-4.15). Similar to the happiness questions and employers' right to shutdown, whether or not respondents endorse that a married woman who wants no more children should be able to get an abortion is predicted by how they responded to the preceding abortion question regarding the chance of a birth defect. When the birth defect question is presented second in the web mode (see Table 4.17), once again the response to the first question is the only significant predictor. However, in the telephone mode when the birth defect question is presented second the likelihood of respondents selecting yes is significantly predicted by age (β=-0.041, SE=0.020, p=.0338), working memory (β=-0.510, SE=0.305, p=.0971), and the answer to the married woman question (β=-4.122, SE=0.693, p<.0001), see Model 1 in Table 4.16. Figure 4.4 shows respondents have a high probability of selecting yes to the birth defect question when they select yes to the married woman question, and this probability is stable for the younger respondents only tapering off slightly for the older respondents as working memory improves. However, even for the older respondents with high working memory, their likelihood of selecting yes to the birth defect question after saying yes to the prior abortion question is still estimated at over 73%.

There is a different pattern when respondents select no to the married question, Figure 4.5, where there is variability among the ages of respondents with low working memory, and as working memory improves the probability of selecting yes to the birth defect question declines. Thus, among the respondents who say no to the married

question there are significant differences across the spectrum of working memory, for all ages, on the likelihood they will say yes to the birth defect question. These results are contrary to expectation where it is expected that the likelihood of selecting yes to birth defect after saying no to the married woman question should increase as working memory increases. As the abortion questions are not clearly defined as part-part or part-whole questions, this ambiguity may contribute to the expected results when the married woman question is presented before the birth defect question.

Figure 4.4: Estimated Probability of Selecting Yes to Abortion for Chance of Birth Defect when Answer Yes to Abortion for Married Woman Wanting No More Children – Telephone

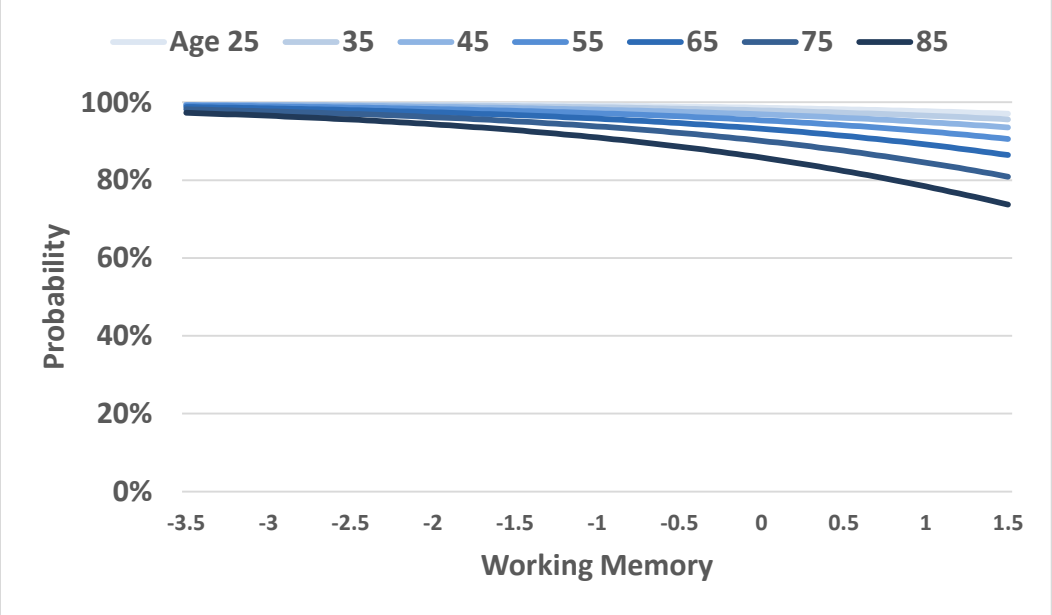


Figure 4.5: Estimated Probability of Selecting Yes to Abortion for Chance of Birth Defect when Answer No to Abortion for Married Woman Wanting No More Children – Telephone

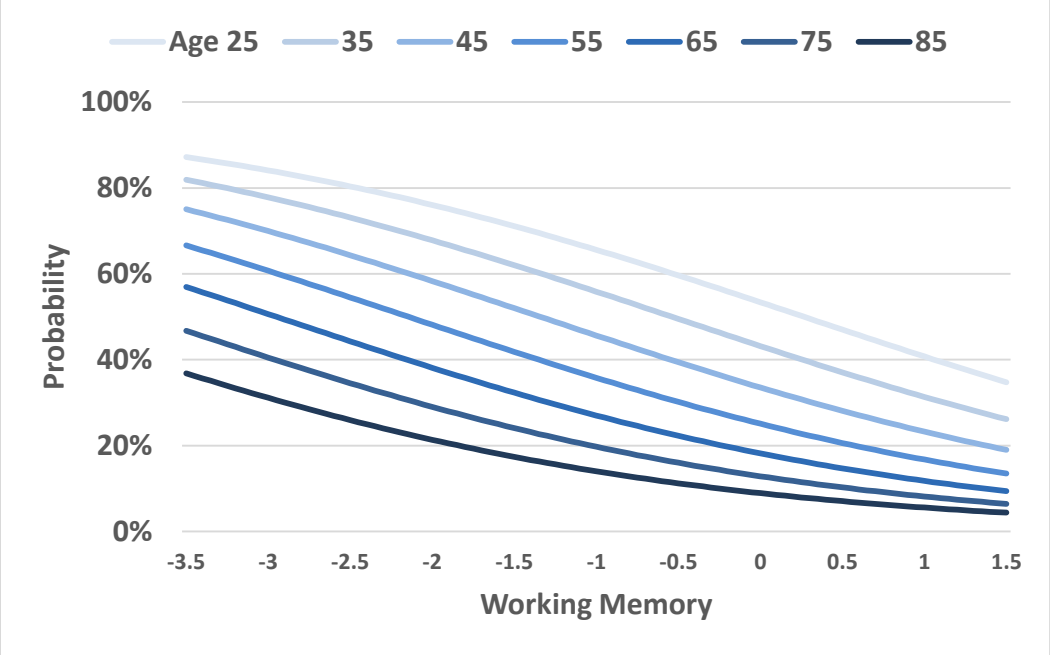


Table 4.14: Logistic Regression – Predicting the Probability of Selecting Yes to "Abortion for Married Woman" when Asked Second – Phone[11]

	Model 1			Model 2			Model 3			Model 4			Model 5		
	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE
Intercept	0.460		1.066	0.470		1.068	0.572		1.084	0.538		1.074	0.544		1.085
Education:															
(Ref) ≤ H.S. grad	--		--	--		--	--		--	--		--	--		--
Tech/Trade/Assoc.'s	1.458	+	0.781	1.469	+	0.786	1.414	+	0.778	1.384	+	0.780	1.337	+	0.780
Some college	0.168		0.912	0.187		0.923	0.148		0.910	0.122		0.911	0.151		0.925
Bachelor's degree	1.082		0.762	1.098		0.772	1.083		0.762	1.059		0.763	1.098		0.775
Post grad degree	1.534	*	0.741	1.547	*	0.747	1.520	*	0.739	1.492	*	0.741	1.511	*	0.746
Age	-0.014		0.015	-0.015		0.015	-0.016		0.015	-0.015		0.015	-0.015		0.015
Working Memory	-0.128		0.252	-0.267		1.037	-0.112		0.251	-0.086		0.256	-0.106		1.070
1st Question Answer:															
(Ref) Yes	--		--	--		--	--		--	--		--	--		--
No	-4.666	****	1.044	-4.658	****	1.045	-7.361		4.664	-4.861	****	1.204	-11.409		14.526
Age*WM				0.002		0.016							0.0002		0.016
(Ref) Age*1st Yes							--		--				--		--
Age*1st No							0.046		0.072				0.108		0.223
(Ref) WM*1st Yes										--		--	--		--
WM*1st No										-0.679		0.806	-11.948		14.503
(Ref)Age*WM*1st Yes													--		--
Age*WM*1st No													0.164		0.219
AICC	152.81			155.04			154.61			154.43			159.64		
BIC	176.11			181.13			180.70			180.51			193.87		

+p<.10, *p<.05, ****p<.0001
Observations = 154

[11]In the abortion questions, using the raw working memory scores, the effect of question order changes to non-significant in Model 4 with both telephone and web (see also Table 4.15).

Table 4.15: Logistic Regression – Predicting the Probability of Selecting Yes to "Abortion for Married Woman" when Asked Second – Web

	Model 1			Model 2			Model 3		Model 4			Model 5	
	Coef.		SE	Coef.		SE	Coef.	SE	Coef.		SE	Coef.	SE
Intercept	1.415		1.343	1.583		1.375	0.859	1.419	1.367		1.351	1.125	1.463
Education:													
(Ref) ≤ H.S. grad	--		--	--		--	--	--	--		--	--	--
Tech/Trade/Assoc.'s	0.558		1.097	0.5454		1.093	0.610	1.127	0.477		1.101	0.495	1.127
Some college	-0.242		0.978	-0.309		0.977	-0.136	0.993	-0.241		0.986	-0.233	0.995
Bachelor's degree	-0.463		0.913	-0.429		0.905	-0.424	0.924	-0.501		0.922	-0.395	0.916
Post grad degree	0.038		0.909	0.108		0.907	0.144	0.927	0.056		0.918	0.256	0.927
Age	-0.018		0.018	-0.021		0.019	-0.008	0.019	-0.017		0.018	-0.013	0.021
Working Memory	-0.275		0.262	1.293		1.072	-0.312	0.276	-0.349		0.292	-1.553	1.205
1st Question Answer:													
(Ref) Yes	--		--	--		--	--	--	--		--	--	--
No	-.3570	****	0.802	-3.526	****	0.802	-0.627	2.396	-3.621	****	0.849	-1.342	2.617
Age*WM				0.019		0.0196						0.023	0.022
(Ref) Age*1st Yes							--	--				--	--
Age*1st No							-0.067	0.058				-0.054	0.060
(Ref) WM*1st Yes									--		--	--	--
WM*1st No									0.653		1.013	2.283	3.213
(Ref)Age*WM*1st Yes												--	--
Age*WM*1st No												-0.035	0.060
AICC	119.85			121.20			120.54		121.70			126.60	
BIC	140.02			143.70			143.04		144.21			155.79	

****p<.0001
Observations = 110

Table 4.16: Logistic Regression – Predicting the Probability of Selecting Yes to "Abortion for Birth Defect" when Asked Second – Phone[12]

	Model 1			Model 2			Model 3			Model 4			Model 5		
	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE	Coef.		SE
Intercept	6.520	***	1.720	6.538	***	1.736	6.695	**	2.313	7.170	***	1.826	6.770	*	2.992
Education:															
(Ref) ≤ H.S. grad	--		--	--		--	--		--	--		--	--		--
Tech/Trade/Assoc.'s	0.018		0.924	0.012		0.928	0.025		0.923	-0.127		0.936	-0.179		0.943
Some college	-1.951		1.206	-1.951		1.208	-1.955		1.207	-2.072	+	1.220	-2.009		1.225
Bachelor's degree	-1.212		0.944	-1.208		0.947	-1.189		0.962	-1.386		0.968	-1.156		0.991
Post grad degree	-2.234	*	0.998	-2.255	*	1.004	-2.244	*	1.008	-2.406	*	1.034	-2.368	*	1.060
Age	-0.041	*	0.019	-0.041	*	0.019	-0.044		0.033	-0.044	*	0.019	-0.039		0.045
Working Memory	-0.510	+	0.305	-0.623		1.202	-0.509	+	0.304	-1.418	+	0.751	1.312		3.399
1st Question Answer:															
(Ref) Yes	--		--	--		--	--		--	--		--	--		--
No	-4.122	****	0.693	-4.116	****	0.693	-4.388	+	2.420	-4.506	****	0.825	-4.518		3.122
Age*WM				0.002		0.019							-0.049		0.056
(Ref) Age*1st Yes							--		--				--		--
Age*1st No							0.004		0.039				0.003		0.050
(Ref) WM*1st Yes										--		--	--		--
WM*1st No										1.096		0.807	-2.623		3.695
(Ref)Age*WM*1st Yes													--		--
Age*WM*1st No													0.066		0.061
AICC		111.91			114.21			114.20			112.22			117.48	
BIC		133.87			138.75			138.75			136.76			149.56	

+p<.10, *p<.05, ****p<.0001
Observations = 133

[12] Using the raw working memory scores there are no differences in the significant effects across all five models.

Table 4.17: Logistic Regression – Predicting the Probability of Selecting Yes to "Abortion for Birth Defect" when Asked Second – Web[13]

	Model 1			Model 2			Model 3		Model 4			Model 5	
	Coef.		SE	Coef.		SE	Coef.	SE	Coef.		SE	Coef.	SE
Intercept	5.198	**	1.944	5.492	**	2.054	9.482	5.932	5.563	*	2.178	10.725	9.208
Education:													
(Ref) ≤ H.S. grad	--		--	--		--	--	--	--		--	--	--
Tech/Trade/Assoc.'s	-0.871		1.378	-0.853		1.403	-0.733	1.374	-0.954		1.387	-0.869	1.398
Some college	-0.677		1.122	-0.538		1.157	-0.594	1.132	-0.755		1.134	-0.585	1.170
Bachelor's degree	-1.042		1.114	-1.084		1.136	-1.072	1.119	-1.089		1.115	-1.206	1.142
Post grad degree	0.089		1.106	-0.331		1.184	0.193	1.107	0.029		1.111	-0.255	1.188
Age	-0.007		0.025	-0.011		0.026	-0.080	0.091	-0.006		0.024	-0.093	0.141
Working Memory	-0.064		0.428	2.171		1.878	-0.084	0.422	-0.907		1.760	0.930	11.988
1st Question Answer:													
(Ref) Yes	--		--	--		--	--	--	--		--	--	--
No	-4.823	****	1.110	-4.951	****	1.117	-9.534	6.044	-5.147	***	1.173	-10.648	9.309
Age*WM				-0.039		0.032						-0.031	0.183
(Ref) Age*1st Yes							--	--				--	--
Age*1st No							0.080	0.094				0.090	0.144
(Ref) WM*1st Yes									--		--	--	--
WM*1st No									0.921		1.810	1.047	12.165
(Ref)Age*WM*1st Yes												--	--
Age*WM*1st No												-0.002	0.187
AICC	74.80			75.65			76.40		76.88			82.17	
BIC	94.25			97.32			98.07		98.55			110.17	

+p<.10
Observations = 102

[13] Using raw working memory scores, question order is not a significant predictor in Model 4.

4.3 Question Order Effects - Discussion

The overall question order effects are not consistent across the questions and modes. For the happiness questions, the chi-square test indicated a marginal difference in the partner question for the web, while the comparison of the correlations indicated a contrast effect in the telephone mode. The labor questions show differences in the modes where the strike question had a significant effect in telephone and not web while the shutdown question had the opposite with significant effects in web but not telephone. There is also an indication of a possible consistency effect in the labor questions. In the abortion questions there were only significant effects in the web mode, both with the chi-square test and comparison of the correlation, but no effects in telephone mode.

Although there is some evidence of overall question order effects in the happiness and abortion questions, there is only moderate evidence to suggest these effects are influenced by respondents working memory. For the happiness set of questions, comparing the correlations of high and low working memory groups shows only a marginally significant contrast effect for the high group. However, across all of the models for the happiness and abortion questions none of the models show there to be a significant interaction of working memory and the response to the first question. The probability of selecting the positive response to the second of the two questions is primarily influenced by the response to first question.

The models for the labor questions provide some evidence that working memory plays a role in how respondents answer the workers' right to strike question when it is presented second. In the telephone mode, working memory and the interaction of working memory and the response to the shutdown question were marginally significant,

along with age as a significant predictor. From Figures 4.1 and 4.2 it can be seen that the probability of endorsing workers' right to strike varies by increasing or decreasing as working memory improves depending on whether respondents say yes or no to the employers' right to shutdown question. For respondents in the web mode, the interaction of age and working memory is significant with both individual predictors remaining marginally significant.

The findings from Knäuper et al. (2007), discussed in Chapter 1, showed there to be question order effects for younger respondents and ($\bar{x}$=29, range 19-42) older respondents ($\bar{x}$=75, range 60-100) with high working memory but no question order effects for older respondents with low working memory. The analysis approach in this dissertation differed than that used by the researchers in Knäuper et al. (2007), for instance, analyzing working memory and age as continuous variables rather than using two distinct age groups and a median split on working memory. However, there is moderate evidence from the labor conditions question to support their findings, in particular between the older respondents. Figures 4.1 and 4.2 show that among the older respondents, those with lower working memory are more likely to exhibit assimilation effects while in comparison those with higher working memory capacity are more likely to exhibit contrast effects. The comparison for the younger respondents is less clear as the earlier study did not separate younger respondents based on working memory capacity. The results from this study, however, do show that the estimated probabilities for younger respondents vary across the levels of working memory similar to the older respondents.

In general, the findings of this chapter do not point towards working memory as having a strong impact on question order effects overall. While question order effects can occur when two related questions are presented to respondents, there appear to be other cognitive processes or behaviors that contribute to these effects. Respondents may engage in behaviors such as acquiescence where they select the response that promotes agreement (i.e., "yes"), or respondents may select the response they feel is socially desirable. Looking at the raw percentages, for each of the sets of question across both modes there are 60-85% of the respondents who selected the same response for both questions. With the data available in this study it is not possible to disentangle respondents who provide a thoughtful response which is consistent with their first response and respondents who provide a consistent response as a result of satisficing. Thus, another explanation for the lack of results indicating a working memory impact is that the behaviors of respondents offset the influence of working memory. It is possible that respondents with lower working memory may use a cognitive shortcut by satisficing while respondents with higher working memory take into account the information from the first question in forming their answer for the second, resulting in both groups of respondents endorsing the same responses while engaging in different cognitive processes. Although there is not strong evidence, the impact of working memory on the labor questions suggests that there are cases where working memory may influence respondents' answers. Further research is needed to determine in which scenarios working memory is more likely to be factor in how respondents formulate their responses on related questions.

CHAPTER 5: COMPARING WORKING MEMORY MEASURES AND A SUBSET OF HEALTH AND RETIREMENT STUDY MEMORY MEASURES

5.1 Scoring Methods

The focus of this chapter is to examine how the working memory measures used in this study compare to a subset of memory measures from the Health and Retirement Study (HRS). The cognitive section of the HRS is used as an example for many other national and international studies such as the National Long-Term Care Survey, the Irish Longitudinal Study on Ageing, China Health and Retirement Longitudinal Study, and others. The publicly available HRS data, including the memory measures, are also used by many researchers to examine a number of different issues facing the older generations. Therefore, it is important to understand whether the memory measures used in the HRS are able to measure the same underlying cognitive construct as measures designed to specifically measure working memory capacity. The working memory measures are designed to require respondents to utilize a short-term temporary storage while simultaneously performing a cognitive task. As outlined in Chapter 2, the measures used in this study were the sentence span and alphabet span. The overall working memory scores from these two measures will be compared to the scores respondents achieved on a subset of HRS measures.

The HRS measures included in the HRS score are the Serial 7s, recalling a list of 10 words, and naming the U.S. Vice President, more detail on these measures is provided in Chapter 2. Respondents received two HRS scores in this study as two different scoring measures were used for the Serial 7s set of questions. In the Serial 7s, respondents were asked to subtract 7 from 100 and to continue subtracting 7 for five iterations. One

scoring method only rewards respondents for exact matches to the correct values, another rewards respondents if they made a correct subtraction even when the value they previously provided was incorrect. For example, a respondent who provided the first two values as 94 and 87 would receive zero points in the "exact values" scoring method and one point in the "correct subtraction" scoring method. The raw scores from these two methods were compared and there are significant differences in the means in both the telephone and web surveys, see Table 5.1. Thus, moving forward scores from both methods will be compared to the scores from the working memory measures.

Table 5.1: Paired t-test Comparing HRS Cognitive Measures with Different Serial 7s Scoring

		Correct Subtraction	Exact Values			
	n	$\bar{X}$	$\bar{X}$	Difference	t	p-value
Telephone	341	10.87	10.44	0.43	8.40	<.0001
Web	260	12.16	11.91	0.25	4.71	<.0001

To determine if the separate set of measures are reflecting the same underlying cognitive construct, the measures will be compared, in each mode, using a variety of methods including a paired t-test, simple linear regression, percent reclassified using both a mean and median split, and substituting HRS scores into a response order effects model from Chapter 3.

5.2 Measures Comparison – Telephone

The first analysis comparing the working memory measures and HRS memory measures is a paired t-test to determine if there is a significant difference in the mean scores. The results, displayed in Table 5.2, show a significant difference in the mean scores between the working memory measures and both scoring versions of the HRS memory measures. The difference in means demonstrates that respondents in the

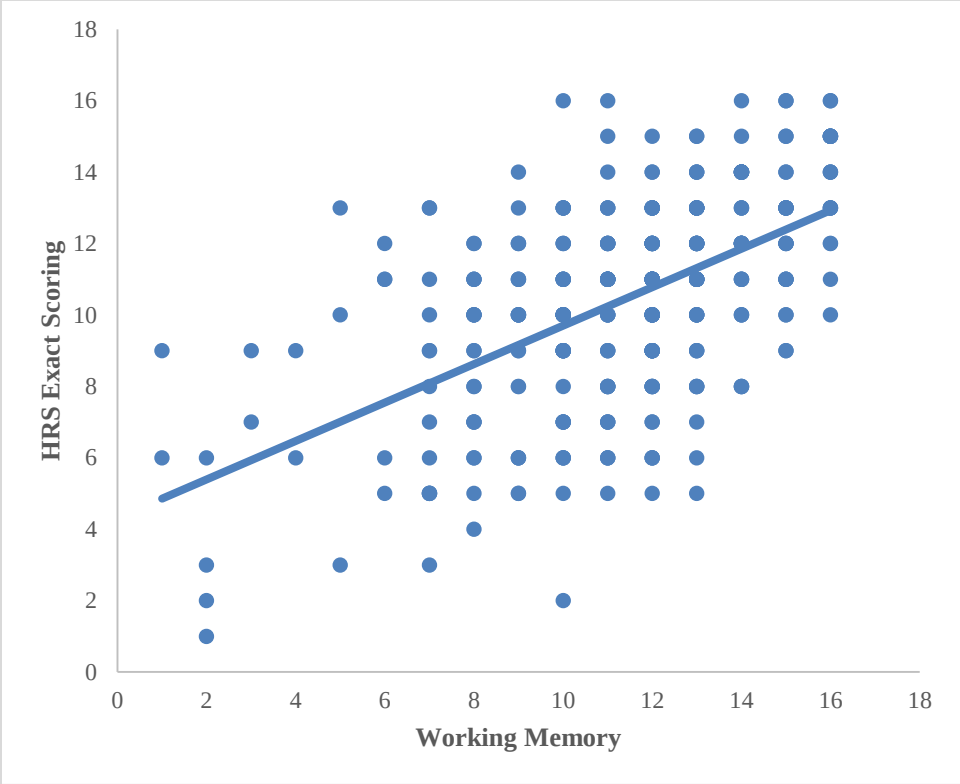
telephone survey performed significantly different on the two sets of measures. Although some of the difference in the scores may be attributed to respondent fatigue as the HRS questions followed the working memory measures, the results do point toward underlying differences between the working memory and HRS measures.

Table 5.2: Paired t-test Comparing Working Memory Measures to both scoring methods of HRS Cognitive Measures - Telephone

	n	Working Memory $\bar{X}$	HRS $\bar{X}$	Difference	t	p-value
Exact Values	341	11.38	10.44	0.94	6.34	<.0001
Correct Subtraction	341	11.38	10.87	0.51	3.54	.0005

Next, the measures were analyzed using a simple linear regression to assess how much variation in one set of measures is accounted for by the other set. First, examining the scores from the exact scoring method, the HRS measures are a significant predictor of the working memory measures ($t=12.27$, $p<.0001$), however, the HRS scores only account for approximately 31% ($r=0.5063$) of the variance in the working memory scores. The correlation coefficient can be used in assessing concurrent or criterion validity, in general the value should be greater than 0.7 to indicate a strong validity, thus the correlation between the working memory & HRS measures does not reflect a strong concurrent validity. Figure 5.1 displays a scatterplot of the scores, with an overlying linear regression line, showing the high variability between the scores from the two sets of measures. The subtraction scores were also analyzed with similar results ($t=14.19$, $p<.0001$, $r^2_{adj}=0.25$, $r=0.5016$).

Figure 5.1: Working Memory by HRS Exact Values – Telephone



The next step is to separate respondents into high and low categories and determine if respondents are classified into the same groups in both sets of measures. Using a median split, respondents below the median are categorized as low and respondents above the median categorized as high, while those with a median score are dropped. Comparing the working memory and exact HRS scores with this method, there are 250 respondents remaining and of those 24% were classified differently. Using a mean split respondents above the mean are classified as high and those with below the mean are classified as low. With the mean split method, of the 341 respondents 110 (32%) were classified differently. Table 5.3 shows the number of respondents classified high in working memory but low in exact HRS measures and vice versa using the median split, and the results of the mean split are shown in Table 5.4. Using the median and

mean split techniques with the HRS subtraction scoring method produced similar results, in the median split 23% of the respondents were classified differently and 31% were classified differently with the mean split.

Table 5.3: Median Split Classification – Telephone

		HRS Exact Values			HRS Correct Subtraction		
		Low	High	Total	Low	High	Total
Working Memory	Low	129 (51.6%)	49 (19.6%)	178 (71.2%)	116 (47.2%)	58 (23.6%)	174 (70.7%)
	High	12 (4.8%)	60 (24.0%)	72 (28.8%)	7 (2.9%)	65 (26.4%)	72 (29.3%)
	Total	141 (56.4%)	109 (43.6%)	250	123 (50.0%)	123 (50.0%)	246

Table 5.4: Mean Split Classification - Telephone

		HRS Exact Scoring			HRS Subtract Scoring		
		Low	High	Total	Low	High	Total
Working Memory	Low	100 (29.3%)	54 (15.8%)	154 (45.2%)	91 (26.7%)	63 (18.5%)	154 (45.2%)
	High	56 (16.4%)	131 (38.4%)	187 (54.8%)	42 (12.3%)	145 (42.5%)	187 (54.8%)
	Total	156 (45.8%)	185 (54.3%)	341	133 (39.0%)	208 (61.0%)	341

5.3 Measures Comparison – Web

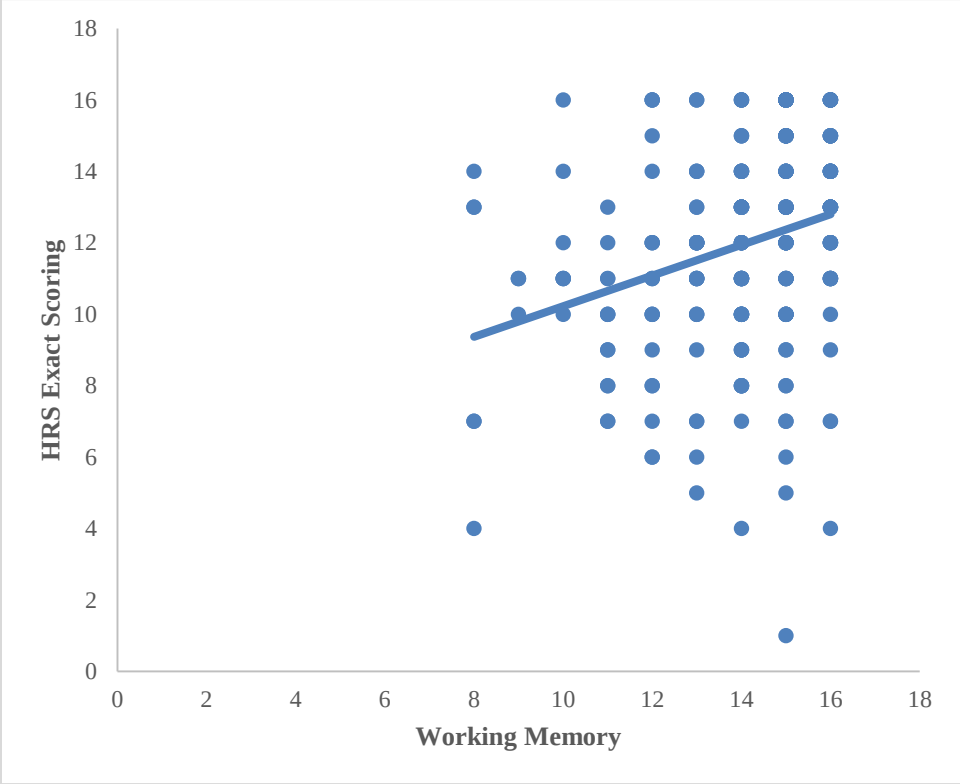
Turning to the web mode, the working memory measures will be compared to the HRS measures in the same set of methods from the previous section. First, a paired t-test shows there is a significant difference in the means between the working memory measures and both scoring methods of the HRS measures. The results are displayed below in Table 5.5.

Table 5.5: Paired t-test Comparing Working Memory Measures to both scoring methods of HRS Cognitive Measures – Web

		Working Memory	HRS			
	n	$\bar{X}$	$\bar{X}$	Difference	t	p-value
Exact Values	260	13.93	11.91	2.02	11.04	<.0001
Correct Subtraction	260	13.93	12.16	1.77	10.18	<.0001

A simple linear regression between the working memory measures and exact scoring of the HRS measures reveals that while significant (t=4.85, p<.0001) the variance accounted for is only 8% with a correlation of r=0.2889. Using the subtraction method measures yielded similar results (t=4.92, p<.0001, r^2_{adj}=.08, r=2928). Figure 5.2 is a scatterplot of the working memory measures and HRS exact scores displaying the wide variability between the measures.

Figure 5.2: Working Memory by HRS Exact Values – Web



The next step focuses on the respondents who are classified differently, high vs. low, using a median split of the measures, see Table 5.6. For this method with the exact HRS scores there were only 174 respondents who were not in the median group, of those 174 respondents 51 (29%) were classified differently between the working memory and

HRS measures. Similarly, with the subtraction scores 28% were classified differently in the high and low categories. When using the mean split, of the 260 respondents 35% and 38% were classified inversely when comparing the working memory measures to the HRS exact and subtraction scores, respectively. The mean split results are shown in Table 5.7

Table 5.6: Median Split Classification – Web

		HRS Exact Values			HRS Correct Subtraction		
		Low	High	Total	Low	High	Total
Working Memory	Low	49 (28.2%)	18 (10.3%)	67 (38.5%)	46 (26.6%)	21 (12.1%)	67 (38.73)
	High	33 (19.0%)	74 (42.5%)	107 (61.5%)	28 (16.2%)	78 (45.1%)	106 (61.3%)
	Total	82 (47.1%)	92 (52.9%)	174	74 (42.8%)	99 (57.3%)	173

Table 5.7: Mean Split Classification – Web

		HRS Exact Scoring			HRS Subtract Scoring		
		Low	High	Total	Low	High	Total
Working Memory	Low	49 (18.9%)	31 (11.9%)	80 (30.8%)	59 (22.7%)	21 (8.1%)	80 (30.8%)
	High	61 (23.5%)	119 (45.8%)	180 (69.2%)	77 (29.6%)	103 (39.6%)	180 (69.2%)
	Total	110 (42.3%)	150 (57.7%)	260	136 (52.3%)	124 (47.7%)	260

Finally, the HRS standardized scores are substituted for the standardized working memory scores in one of the response order effects models from Chapter 3. The model selected is predicting a late response for the combined modes and combined questions of Q4-Q6 where the two-way interaction of working memory*mode is significant along with a significant three-way interaction of age*working memory*mode. For both scoring methods of the HRS measures, the new models produced all non-significant results, see

Table 5.8 for the comparison. The non-significant results provide additional evidence of the differences between the sets of measures.

Table 5.8: Multilevel Logistic Regression – Predicting the Probability of Selecting a Late Response Option (Across Q4-Q6) – Measures Comparison

	Working Memory			HRS Exact Values			HRS Correct Subtraction		
	Coef.		SE		Coef.	SE		Coef.	SE
Intercept	-0.465		0.333	Intercept	-0.482	0.328	Intercept	-0.471	0.328
Controls				Controls			Controls		
Question Number:				Question Number:			Question Number:		
(Ref) Q4	--		--	(Ref) Q4	--	--	(Ref) Q4	--	--
Q5	-0.196		0.127	Q5	-0.192	0.126	Q5	-0.193	0.126
Q6	-0.125		0.123	Q6	-0.123	0.123	Q6	-0.124	0.123
Education:				Education:			Education:		
(Ref) ≤ H.S. grad	--		--	(Ref) ≤ H.S. grad	--	--	(Ref) ≤ H.S. grad	--	--
Tech/Trade/Assoc.'s	0.005		0.204	Tech/Trade/Assoc.'s	-0.014	0.204	Tech/Trade/Assoc.'s	-0.006	0.204
Some college	-0.109		0.231	Some college	-0.145	0.231	Some college	-0.142	0.232
Bachelor's degree	0.071		0.199	Bachelor's degree	0.064	0.199	Bachelor's degree	0.079	0.199
Post grad degree	0.088		0.200	Post grad degree	0.087	0.200	Post grad degree	0.102	0.200
Predictors				Predictors			Predictors		
Age	-0.001		0.005	Age	-0.001	0.005	Age	-0.001	0.005
Working Memory	-0.232		0.296	HRS Exact Score	-0.041	0.246	HRS Sub	-0.146	0.246
Mode:				Mode:			Mode:		
(Ref) Telephone	--		--	(Ref) Telephone	--	--	(Ref) Telephone	--	--
Web	-0.121		0.429	Web	-0.047	0.420	Web	-0.055	0.420
Interactions				Interactions			Interactions		
Age*WM	0.003		0.005	Age*HRS Exact	0.001	0.004	Age*HRS Sub	0.002	0.004
(Ref) Age*Phone	--		--	(Ref) Age*Phone	--	--	(Ref) Age*Phone	--	--
Age*Web	0.001		0.007	Age*Web	0.001	0.007	Age*Web	0.001	0.007
(Ref) WM*Phone	--		--	(Ref) HRS Exact*Phone	--	--	(Ref) HRS Sub*Phone	--	--
WM*Web	1.077	*	0.466	HRS Exact*Web	0.3911	0.395	HRS Sub*Web	0.462	0.405
(Ref)Age*WM*Phone	--		--	(Ref)Age*HRSE*Phone	--	--	(Ref)Age*HRSS*Phone	--	--
Age*WM*Web	-0.017	*	0.007	Age*HRS Exact*Web	-0.006	0.007	Age*HRS Sub*Web	-0.007	0.007
Respondent Variance	0.138	+	0.097	Respondent Variance	0.148	+ 0.097	Respondent Variance	0.147	+ 0.097
-2 Res.Log Likelihood		7447.87		-2 Res.Log Likelihood		7442.42	-2 Res Log Likelihood		7442.80
Generalized X^2		1642.20		Generalized X^2		1638.51	Generalized X^2		1638.83

+p<.10, *p<.05
Observations=1710

5.3 Measures Comparison - Discussion

Taken together, the results point toward the two sets of measures reflecting separate underlying cognitive constructs. Although the measures in the telephone mode are correlated at r=0.5063 and r=0.2889 in the web, it is not a high enough correlation to suggest a strong concurrent validity between the measures. Additionally, over 20% of the respondents were classified differently, high vs. low, when using a median split on and over 30% when using a mean split. Earlier in Chapter 3, the model for predicting a late response on the combined questions Q4-Q6 yielded both a significant working memory by mode interaction and significant three-way interaction of age, working memory and mode. Substituting the HRS measures for working memory resulted in models with no significant effects. Thus, across both modes the memory measures and HRS measures are not performing equivalently. These results suggest that while the HRS measures capture some cognitive abilities they do not appear to adequately reflect working memory capacity.

CHAPTER 6: CONCLUSIONS AND LIMITATIONS

6.1 Conclusions and Discussion

The results from Chapter 3 indicate that working memory capacity can impact the response option selected by respondents, such that the level of a respondent's working memory capacity may make it more or less likely that a respondent will select a response option based on its location (i.e., early or late) in a list of options. For both a long list of options and a short list of only two, the results show a significant three-way interaction of age, working memory, and mode. Although I hypothesized that effects of working memory would be consistent across respondents of all ages, the findings often revealed opposite effects for respondents under the age of 65 and respondents older than 65, as displayed in the Chapter 3 Figures. For instance, among younger adults an improvement in working memory generally led to respondents being less susceptible to select the response option associated with response option effects (i.e., early in web, late in telephone). However, on the contrary, for the older adults, especially those 75 and older, an increase in working memory capacity often reflected an increase in the likelihood of selecting an early response in web or a later response in telephone. It is unclear at this juncture why the effects of working memory are so different for younger and middle aged adults compared to older adults when it comes to response order effects. Further research is needed addressing some of the limitations of this study such as a controlled environment of the administration of working memory measures and variety of attitudinal questions (described in more detail later) to examine whether these opposing effects are maintained under other conditions.

It was expected that working memory would have a significant effect on question order effects such that respondents with a higher working memory capacity would be more influenced by the first question than those with lower working memory capacity. Overall, however, the results from Chapter 4 provide only moderate evidence to support that question order effects are impacted by working memory capacity. The evidence that exists comes from the models for the labor conditions questions. In both telephone and web, the likelihood of selecting yes to the strike question varied as a result of the interaction of working memory and the answer to the shutdown question. Additionally, comparing the contrast effects in the happiness questions did indicate that respondents with higher working memory had a marginally significant contrast effect compared to no contrast effect for those with lower working memory. While the evidence does not fully support an influence of working memory on question order effects, the little evidence that is present does promote the need for further studies on question order effects and the underlying cognitive processes that may contribute to the effects.

A set of tests was used in evaluating the working memory measures and HRS cognitive measures to provide a well-rounded look at the comparison. In each of the tests and comparisons, the evidence supported that the working memory measures and HRS measures reflect separate underlying constructs. A test of the means shows significant differences in the mean raw scores while a simple linear regression showed that although the measures are correlated the correlations are too low to indicate a strong concurrent validity. By splitting the measures on both the mean and median and classifying respondents as high and low the results show that over 20% of the respondents on the median split and over 30% of respondents on the mean split were classified differently on

their working memory scores than their HRS scores. Finally, selecting a model where working memory yielded significant results and substituting the HRS measures, which yielded non-significant results, was another indicator of the differences between the sets of measures.

6.2 Contribution to Cognitive Aspects of Survey Methodology

The previous work by Knäuper and colleagues began the groundwork for understanding how survey respondents' working memory impacts the answer they provide on survey questionnaires. The work in this dissertation was aimed at taking a closer look by including working memory measures for the respondents directly into the questionnaire and examining working memory capacity on response order and question order effects.

Although this survey did not produce overall response order effects, the results still indicate that working memory can influence the location of the response order selected by respondents. The results show differences across modes of administration and across respondents' ages from the younger adults at age 25 to the older adults at age 85. While the figures in Chapter 3 clearly show differences based on age, there is also an interaction with working memory such that, for instance, younger respondents with lower working memory are more/less likely to select a response option in a particular location compared to younger respondents with higher working memory. The same hold for older respondents also. This empirical evidence provides support to previous suggestions that response options should be randomized, both in interview- and self-administered modes. By failing to randomize response options researchers may bias the substantive results of their surveys.

While Knäuper theorized that working memory plays a role in question order effects, there is little evidence from this dissertation to support this notion. While question order effects can occur such that respondents' answers to a question are influenced by the presence of an earlier, related question, working memory does not appear to be a significant contributor to the effects. From the results, there appear to be other cognitive processes contributing to question order effects. As reported in Chapter 4, a large percentage of respondents provided the same responses to both questions in each pair of questions. It is possible that these responses reflect the true attitudes of respondents as the questions are on related topics or respondents may be engaging in satisficing behaviors to shortcut the cognitive response process. However, with the data available from this study I am unable to determine when consistent responses are the result of thoughtful cognitive processing and when they are the result of satisficing. The current recommendation for researchers follows previous best-practice suggestions that including filler questions between related questions may help to minimize the influence of the first question on the second. The limitations of this study, outlined in the next section, may have contributed to the lack of support for the influence of working memory on question order effects, and future studies are needed for more evidence on the cognitive processes that impact responses on related questions.

One of the objectives of this dissertation was to compare a subset of the cognitive measures from the Health and Retirement Study (HRS) to measures designed for working memory. The HRS is an ongoing national survey of older adults that containing a section of cognitive measures that has been used as an example for other national and international surveys. Therefore, I wanted to examine whether the cognitive measures

included were able to reflect respondents' working memory capacity as well as measures designed specifically for assessing working memory. The results provide evidence to support that the HRS cognitive measures reflect a separate cognitive construct than the working memory measures. While the survey only included a subset of the HRS measures, it appears that the cognitive section of the HRS may not be able to reflect the working memory capacity of the respondents. It is recommended that the HRS and similar surveys include some specific working memory measures, many of which are described in Chapter 1, to capture the differences in working memory capacity among the respondents. Including these additional measures would help to enhance the overall understanding of the cognitive functioning of the respondents included in such surveys.

6.3 Limitations and Future Research

The experiment conducted for this research has several limitations. Most notably, the administration of the cognitive measures were not conducted in a controlled environment. Although respondents were instructed that they would not need to use any pen, pencil, or paper to complete the survey, there was no one present to monitor whether respondents used aids to assist with answering the cognitive questions. Thus, the data from the both the working memory and HRS measures could be biased and reflect higher scores than normal if respondents did not rely solely on their memory and cognitive ability.

In addition to the lack of controlled environment, the cognitive measures were administered differently across respondents with some being presented the questions visually and others receiving the questions orally. The differences in administration of the working memory measures may have contributed to the lower correlations between

age and working memory in the web mode. Additionally, I was required to make assumptions about the scores between modes, determining how to use them in the analyses. Future research would benefit from administering the cognitive measures consistently across all respondents and separately from the attitudinal questions, which could still be administered in dual modes.

In examining the impact of working memory on both the response order effects and question order effects, multiple models were tested. Thus, there is some skepticism that the resulting significant p-values reflect actual significance. It would be beneficial to have future studies to in in both areas to determine if the significant findings in the current study are replicated.

Respondent fatigue is another limitation that may have interfered with performance on the cognitive measures. Respondents were presented the working memory measures after the attitudinal questions and the HRS measures following the working memory measures. Requiring respondents to answer both the attitudinal questions and cognitive measures in the same survey may have led to poorer performances than if the questions and measures had been administered separately. Additionally, having the HRS follow the working memory measures rather than rotating or interspersing them could have contributed to the lower mean scores for the HRS measures compared to the working memory measures.

With using the questions on labor conditions and abortion for the question order effects, I did not want any other questions that may have appeared politically motivated as the survey was administered near the time of the 2016 Presidential election. Thus, to test response order effects I created attitudinal questions about entertainment preferences

that I hoped would be salient across a wide variety of demographics groups. I also wanted questions that would hold the attention of respondents to keep them engaged in the survey. However, by doing so there is no variety in the types of questions and responses. Further research into the effects of working memory on response order effects should include more variety in the types of questions, including response option scales which reverse the options high to low and low to high.

A potential limitation on the web survey was including a Don't know/Refuse option (see Figure 6.1). This option was included on the web to allow respondents a way to provide a non-substantive answer just as they were allowed to on the telephone version, however, including the option for the web version may have influenced the visual attention given to the substantive response options. A future experiment could leave off the option forcing respondents to choose a substantive response.

There are also limitations with regarding the demographics of the survey respondents which may limit the generalizability of some of the results. Overall, the respondents are skewed to a slightly older demographic with the mean age of 55.68. There was also a slight marginal difference in the mean ages of the telephone and web surveys. Additionally, the survey was administered only to residents of Nebraska, a conservative state, which may have impacted the question order results, particularly in regards to the abortion questions.

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APPENDIX A: BUREAU OF SOCIOLOGICAL RESEARCH SURVEY

METHODOLOGY REPORT

Beth Cochran Survey Methodology Report

Prepared: January 2017

The contents of this report conform to our highest standards for data collection and reporting. If you should have any questions or concerns regarding the information reported within, please contact us.

Bureau of Sociological Research
Department of Sociology
PO Box 880325 • Lincoln, NE 68588-0325
402-472-3672 (local) • 800-480-4549 (toll free)
email: bosr@unl.edu • http://bosr.unl.edu

Contents

Overview

This survey was conducted by the Bureau of Sociological Research (BOSR) at the University of Nebraska-
Lincoln (UNL) on behalf of Beth Cochran, a PhD student in UNL's Department of Survey Research and Methodology. The study was funded by a grant from the National Science Foundation. The questionnaire was conducted in two separate modes: web and mail. All surveys were administered in English.

Sample

The sample for the study was drawn from two sources. Initial sample came from the previous three years (2014, 2015, and 2016) of the Nebraska Annual Social Indicators Survey (NASIS) Future Research Card. This is a database of previous NASIS (an annual survey of Nebraska households conducted by BOSR) respondents who have indicated they are interested in participating in future research. These respondents were randomly assigned to either the web or phone condition. A total of 1,116 cases of the sample came from the NASIS Future Research Card (558 for each condition/mode).

The remainder of the sample was made up of an address-based sample (ABS) of Nebraska households. To reach a desired sample size of 3,700, 2,584 ABS cases were ordered from Survey Sampling Inc. The ABS cases were then randomly assigned to the phone and web conditions (1,292 cases each).

Data Collection

Web data collection consisted of a postal letter sent to Nebraska households directing an adult age 19 or older in the household to the internet to complete the survey. An initial letter was sent to households on November 10, 2016. A follow-up letter was sent to all nonrespondents on November 30, 2016. Data collection for the web portion of the survey ended on December 20, 2016. Letters instructed any adult age 19 or older in the household to complete the survey. A copy of each of the letters can be found in Appendix A3. The web questionnaire was programmed using Lime Survey. A copy of the web questionnaire can be found in Appendix A1.

Phone data collection consisted of a postal letter sent to Nebraska households that included a Phone Number Request Card and a postage-paid business reply envelope. Respondents filled out their phone numbers on the card and mailed those cards back to BOSR. BOSR then called the numbers provided to complete the phone survey. It should be noted that sample members assigned to the phone condition drawn from the NASIS Future Research Card who had previously provided a phone number were not sent a mailing. Instead, they were called directly from the start of the study. An initial mailing, including letter, Phone Number Request Card and business reply envelope, was sent to households on November 4, 2016. A follow-up letter along with another Phone Number Request Card and business reply envelope were mailed to nonrespondents on November 28, 2016. BOSR started calling on November 9, 2016, and ended calling on January 13, 2017. A copy of each of the letters can be found in Appendix A4 and a copy of the Phone Number Request Card can be found in Appendix A5. The phone questionnaire was programmed and administered in Voxco's CATI software. Interviewers asked for

any adult age 19 or older to complete the survey. A copy of the questionnaire can be found in Appendix A2.

The questionnaire contained six different versions in order to control for response order effects and question order effects. All cases in the sample were randomly assigned to one of the six versions before the first letters were mailed. Questions 1 through 12 were varied between the six versions. An outline of differences between versions can be found in Appendix A6.

Response Rate

Since this survey is multi-modal and the phone version contains several steps to response, three separate response rates will be reported: response rate to the web versions, response rate on phone number cards returned, and response rate on phone calls made. Response rates presented here are calculated using AAPOR standard definition for response rate 1.

For the web survey, AAPOR RR 1 was 13.7%. Refusals (e.g., letter, phone call, or e-mail stating refusal to participate) and refused mail were obtained from 0.1% (n=2) of the sample. However, from the original sample 86 (4.6%) letters were returned undeliverable. Thus, adjusting for known ineligibles and undeliverable returns, the adjusted response rate is 14.4%.

For the Phone Number Request Card, AAPOR RR 1 was 10.4%. Refusals (e.g., black card returned; or a letter, phone call, or e-mail stating refusal to participate) and refused mail were obtained from 0.1% (n=2) of the sample. However, from the original

sample 75 (5.2%) letters were returned undeliverable. Thus, adjusting for known ineligibles and undeliverable returns, the adjusted response rate is 10.9%.

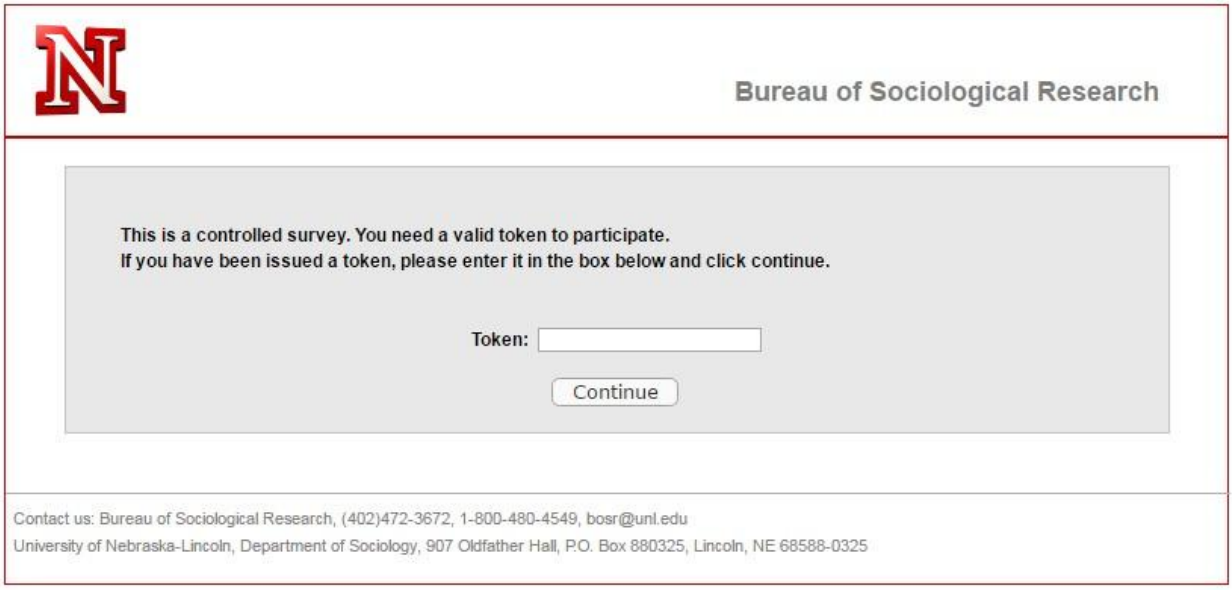
For the phone survey, AAPOR RR 1 was 66.9%. Refusals were obtained from 16.3% (n=83) of the sample. However, from the original sample 86 (4.6%) letters were returned undeliverable. Thus, adjusting for known ineligibles and undeliverable returns, the adjusted response rate is 14.4%. 7.3% (n=41) cases were deemed ineligible due to being disconnected numbers, fax/data lines, or non-residences.

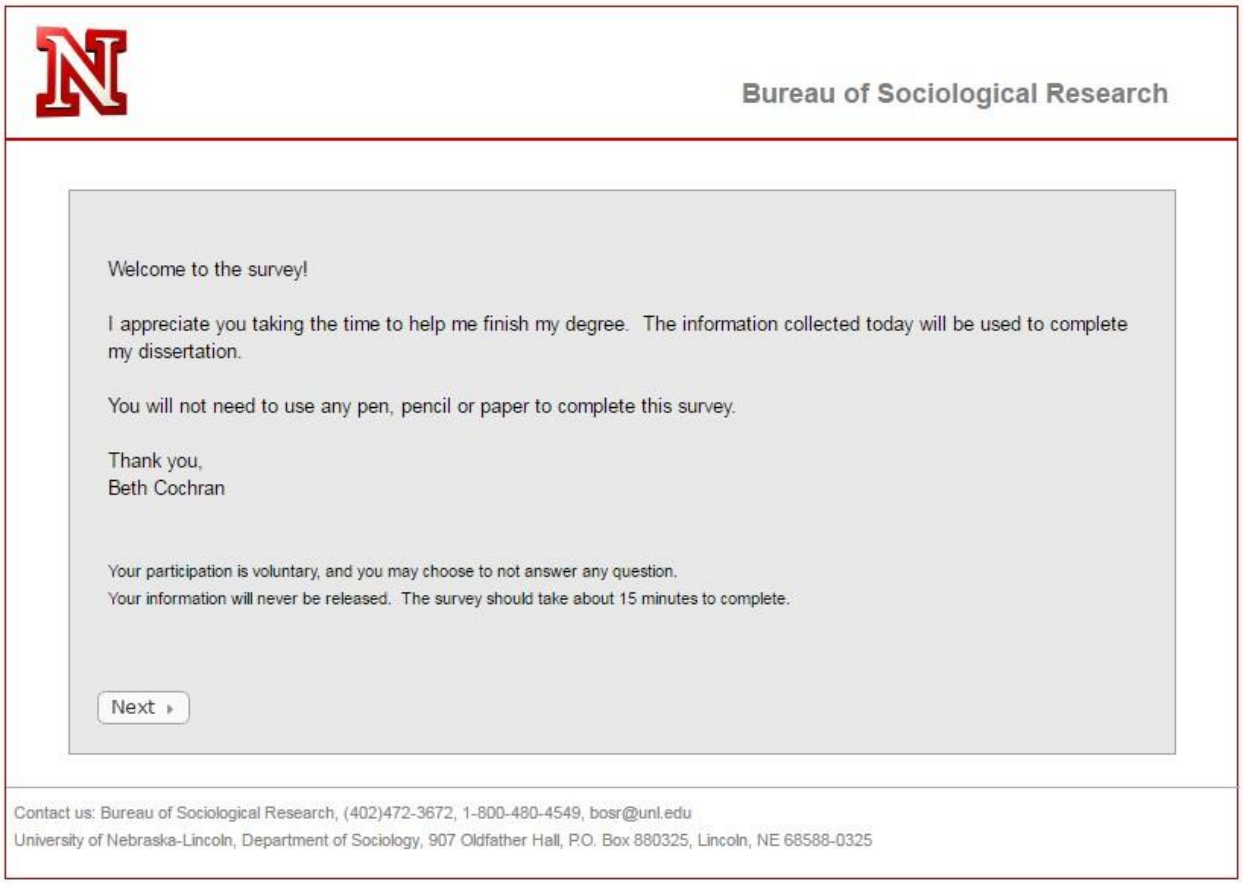
Summary

Any questions regarding this report or the data collected can be directed to the Bureau of Sociological Research at the University of Nebraska-Lincoln by calling (402) 472-3672 or by sending an e-mail to bosr@unl.edu.

Appendix A1: Web Questionnaire

Presented here is the questionnaire as it appears in Version 1. See Appendix A7 for differences between versions.






Bureau of Sociological Research
This first set of questions ask about your opinion on a variety of topics. Of the following, which type of book do you prefer to read?
Fiction
Non-fiction
Don't know/Refuse
Next
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University of Nebraska-Lincoln, Department of Sociology, 907 Oldfather Hall, P.O. Box 880325, Lincoln, NE 68588-0325


Bureau of Sociological Research
Of the following, which type of movie do you prefer to watch?
Action
Drama
Don't know/refuse
Next
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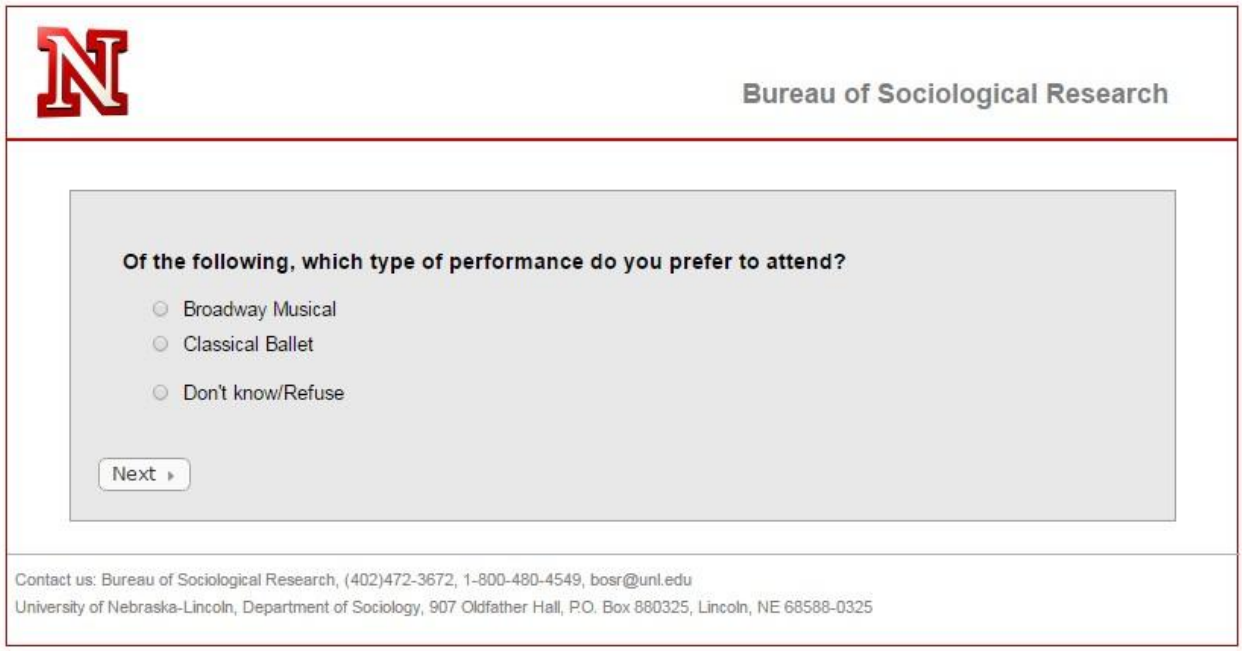
Bureau of Sociological Research
Of the following, which type of performance do you prefer to attend?
Broadway Musical
Classical Ballet
Don't know/Refuse
Next
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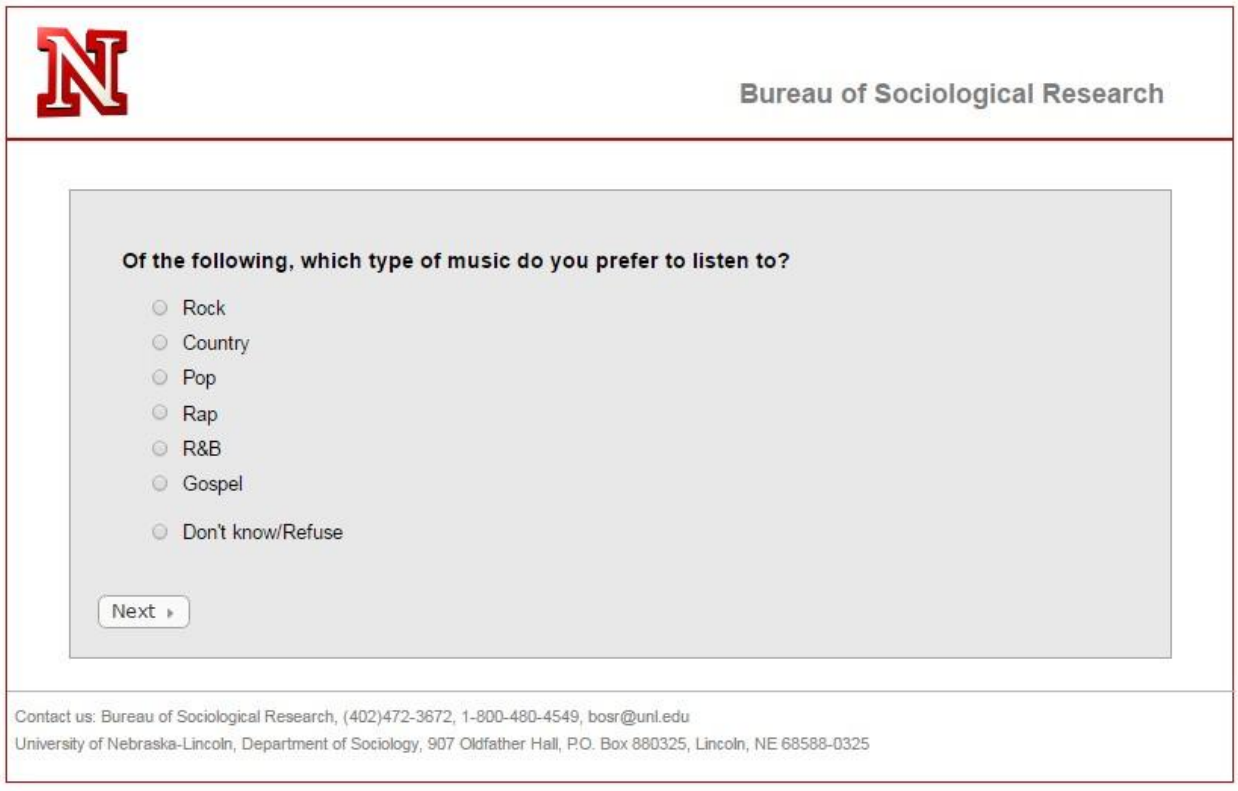
Bureau of Sociological Research
Of the following, which type of music do you prefer to listen to?
Rock
Country
Pop
Rap
R&B
Gospel
Don't know/Refuse
Next
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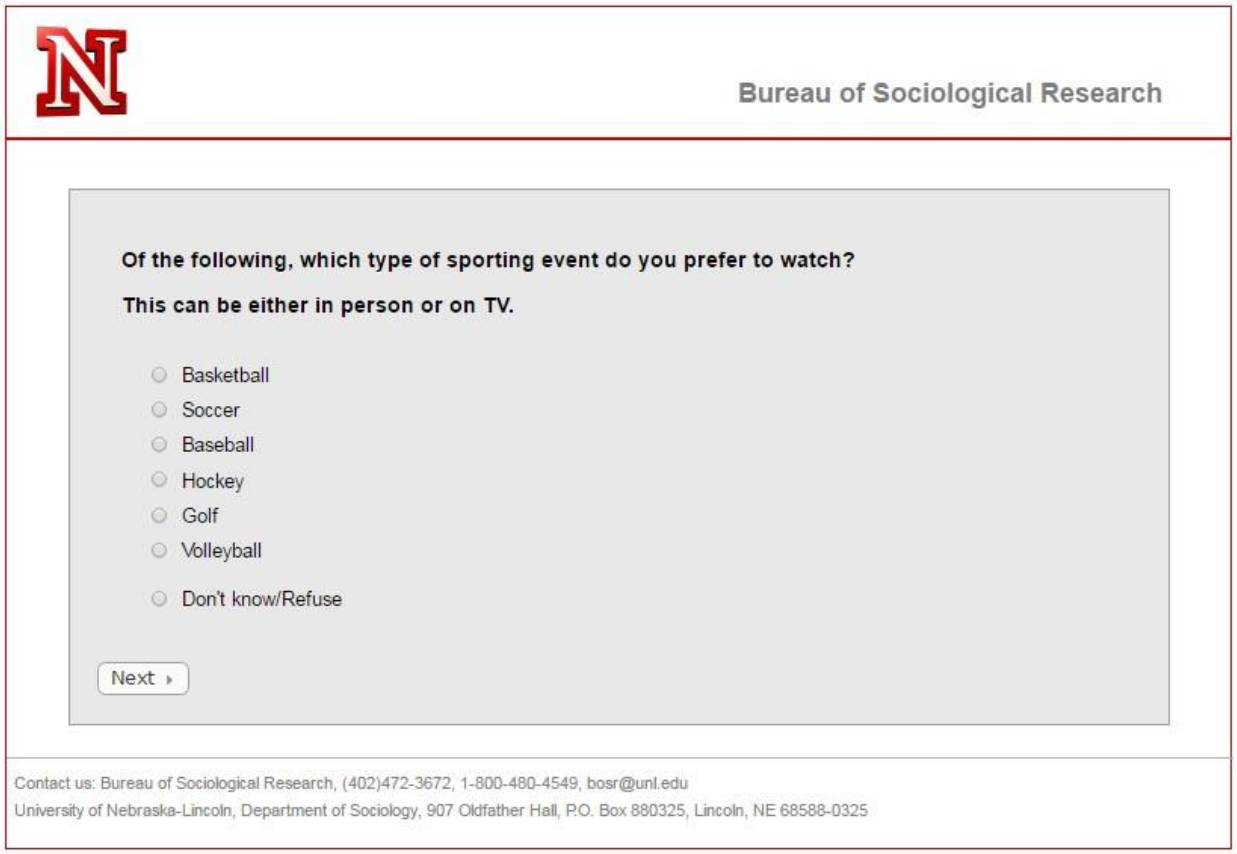

Bureau of Sociological Research

Of the following, which type of sporting event do you prefer to watch?

This can be either in person or on TV.

- Basketball
- Soccer
- Baseball
- Hockey
- Golf
- Volleyball
- Don't know/Refuse

Next

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Bureau of Sociological Research

Of the following, which type of attraction do you prefer to visit?

- Art Museum
- Amusement Park
- Historical Monument
- State Capitol Building
- Science Museum
- National Park
- Don't know/Refuse

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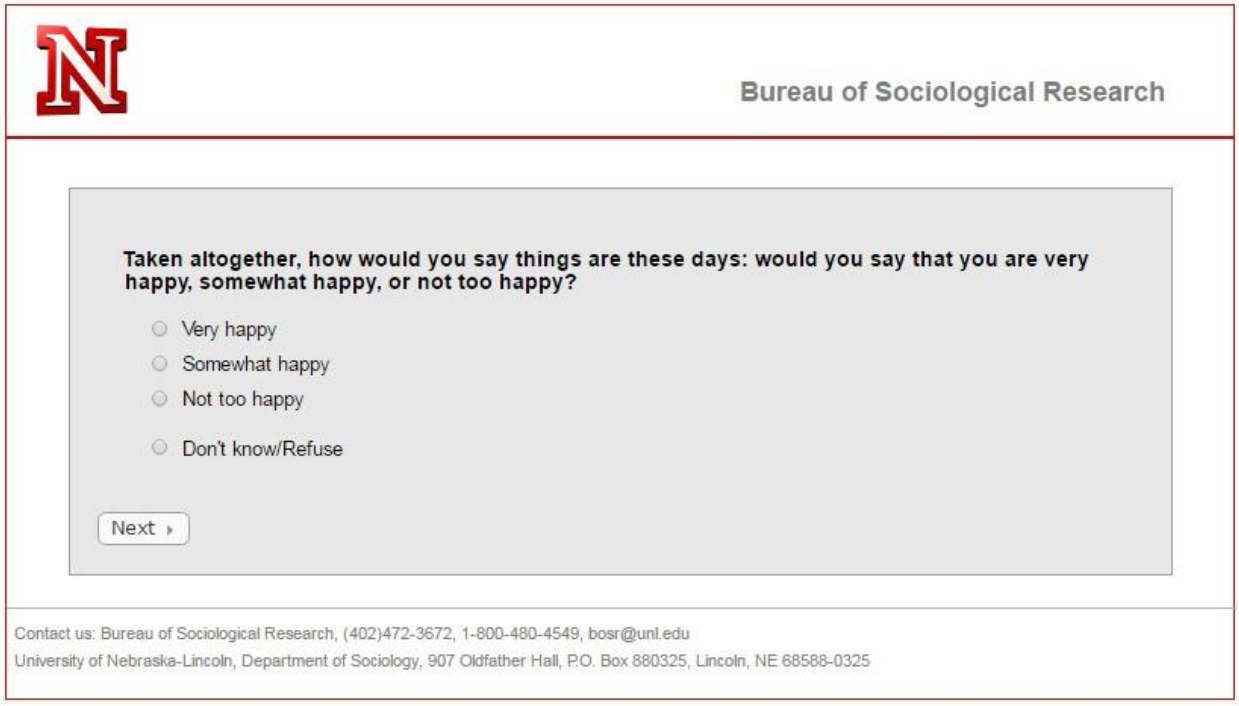
Bureau of Sociological Research
Taken altogether, how would you say things are these days: would you say that you are very happy, somewhat happy, or not too happy?
Very happy
Somewhat happy
Not too happy
Don't know/Refuse
Next
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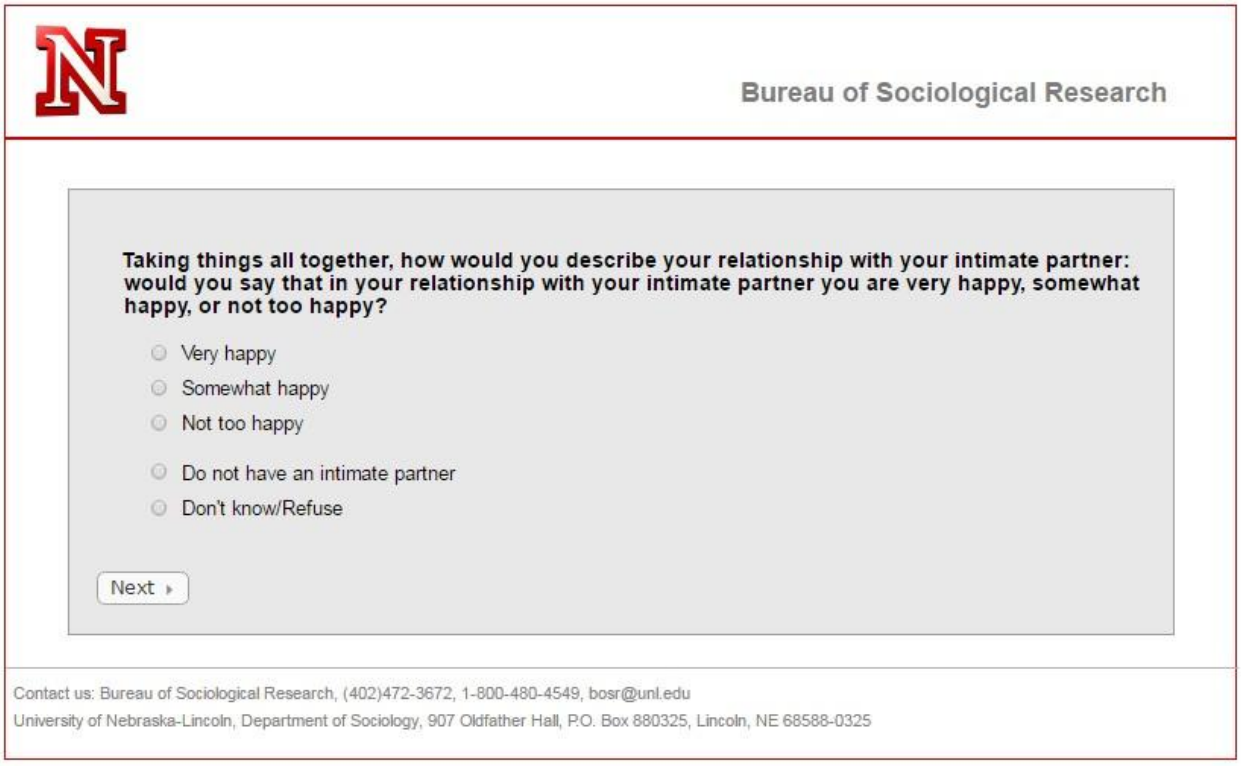
Bureau of Sociological Research
Taking things all together, how would you describe your relationship with your intimate partner: would you say that in your relationship with your intimate partner you are very happy, somewhat happy, or not too happy?
Very happy
Somewhat happy
Not too happy
Do not have an intimate partner
Don't know/Refuse
Next
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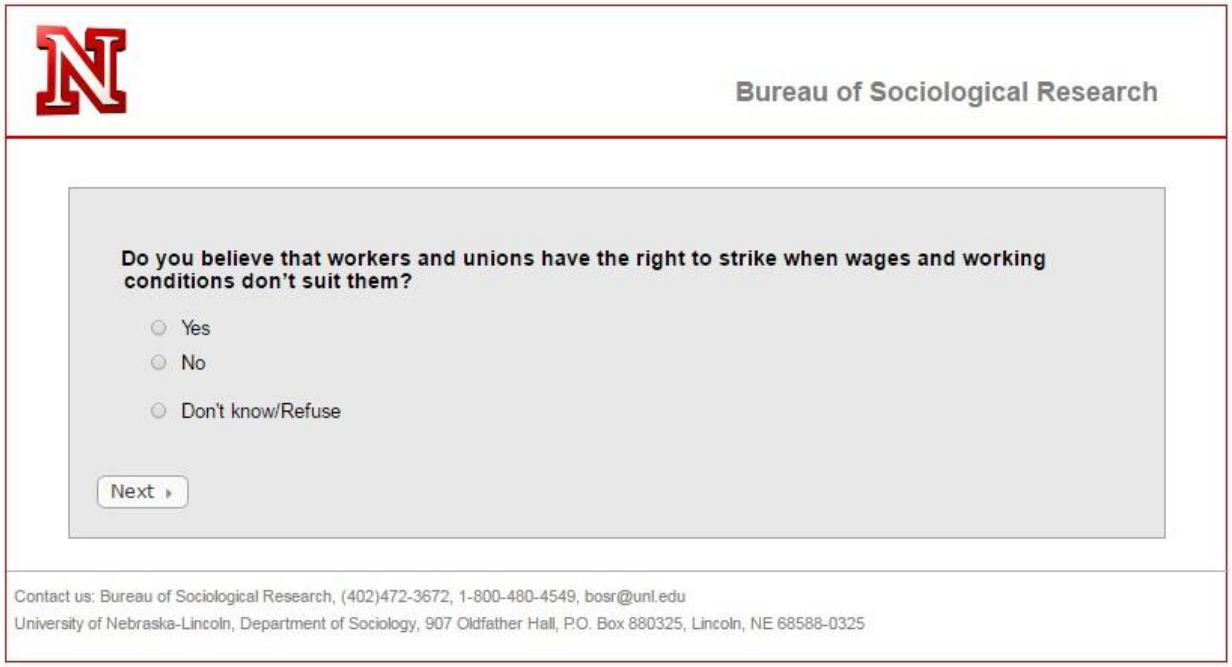
Bureau of Sociological Research
Do you believe that workers and unions have the right to strike when wages and working conditions don't suit them?
Yes
No
Don't know/Refuse
Next
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Bureau of Sociological Research
Do you believe that businessmen have a right to shut down their factories and stores when labor conditions and profits don't suit them?
Yes
No
Don't know/Refuse
Next
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Bureau of Sociological Research
Do you think it should be possible for a pregnant woman to obtain a legal abortion if she is married and does not want any more children?
Yes
No
Don't know/Refuse
Next
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Bureau of Sociological Research
Do you think it should be possible for a pregnant woman to obtain a legal abortion if there is a strong chance of serious defect in the baby?
Yes
No
Don't know/Refuse
Next
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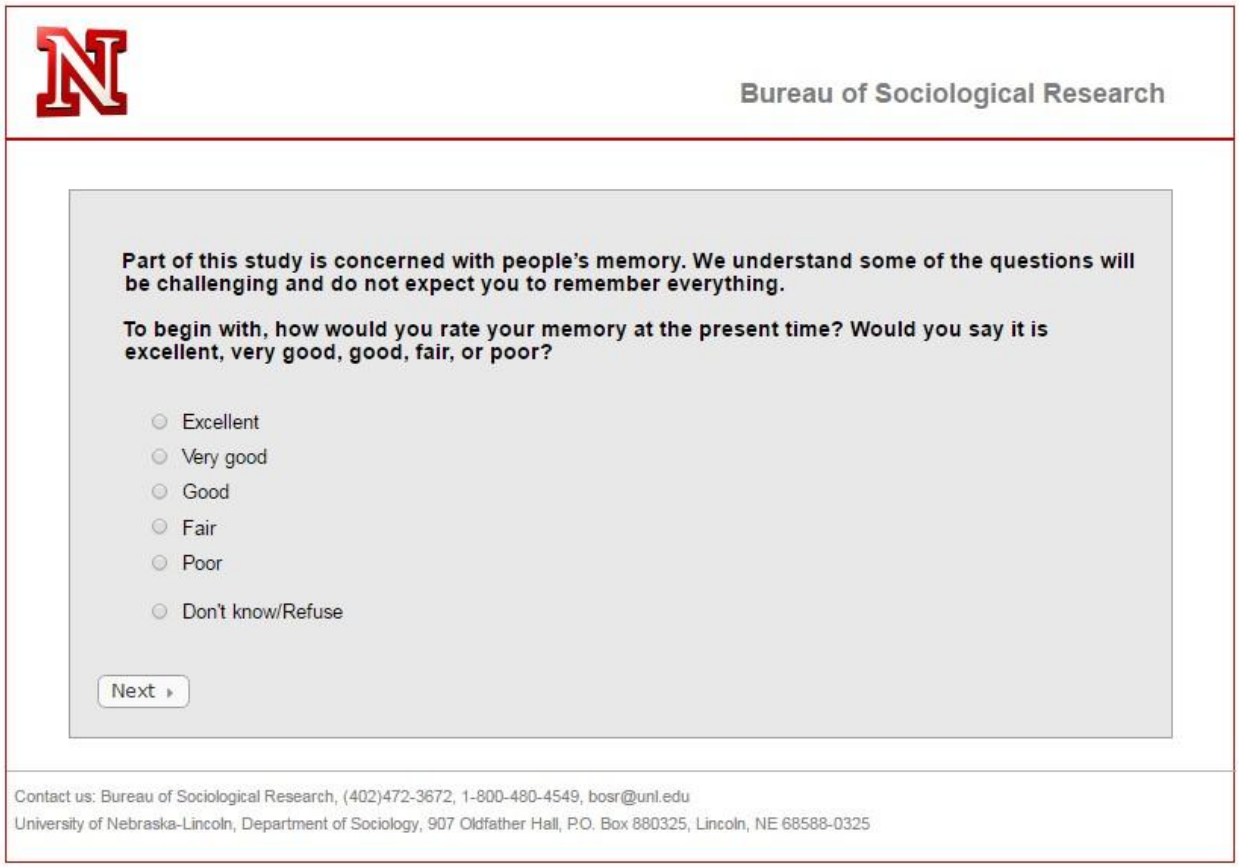
Bureau of Sociological Research
Part of this study is concerned with people's memory. We understand some of the questions will be challenging and do not expect you to remember everything.
To begin with, how would you rate your memory at the present time? Would you say it is excellent, very good, good, fair, or poor?
Excellent
Very good
Good
Fair
Poor
Don't know/Refuse
Next
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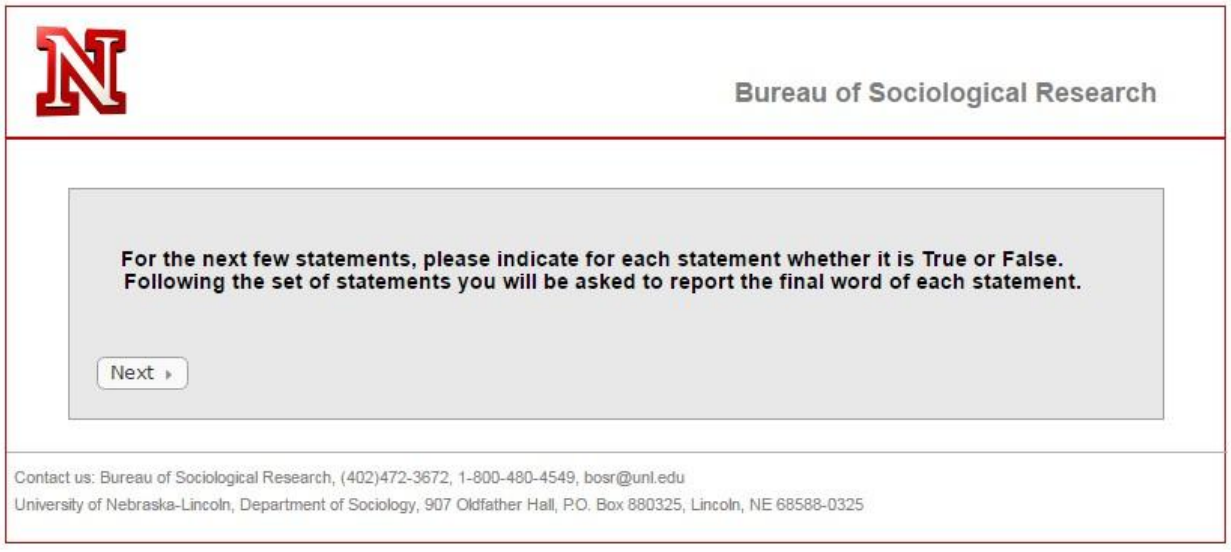
Bureau of Sociological Research
For the next few statements, please indicate for each statement whether it is True or False. Following the set of statements you will be asked to report the final word of each statement.
Next
Contact us: Bureau of Sociological Research, (402)472-3672, 1-800-480-4549, bosr@unl.edu
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Bureau of Sociological Research
A clock is used to tell time.
True
False
Don't know/Refuse
Next
Contact us: Bureau of Sociological Research, (402)472-3672, 1-800-480-4549, bosr@unl.edu
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Bureau of Sociological Research
Grass is the color blue.
True
False
Don't know/Refuse
Next
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Bureau of Sociological Research
Birds fly in the sky.
True
False
Don't know/Refuse
Next
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Bureau of Sociological Research
Please report the last word of each statement, in any order
Don't know/Refuse
Next
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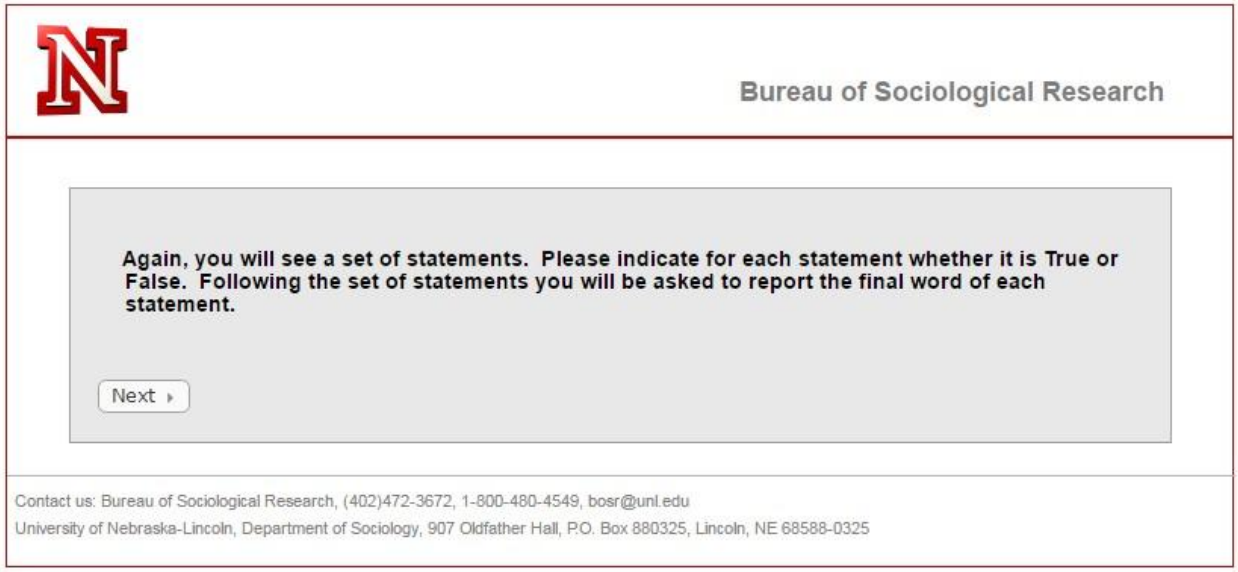
Bureau of Sociological Research
Again, you will see a set of statements. Please indicate for each statement whether it is True or False. Following the set of statements you will be asked to report the final word of each statement.
Next
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Bureau of Sociological Research
Fish walk on land.
True
False
Don't know/Refuse
Next
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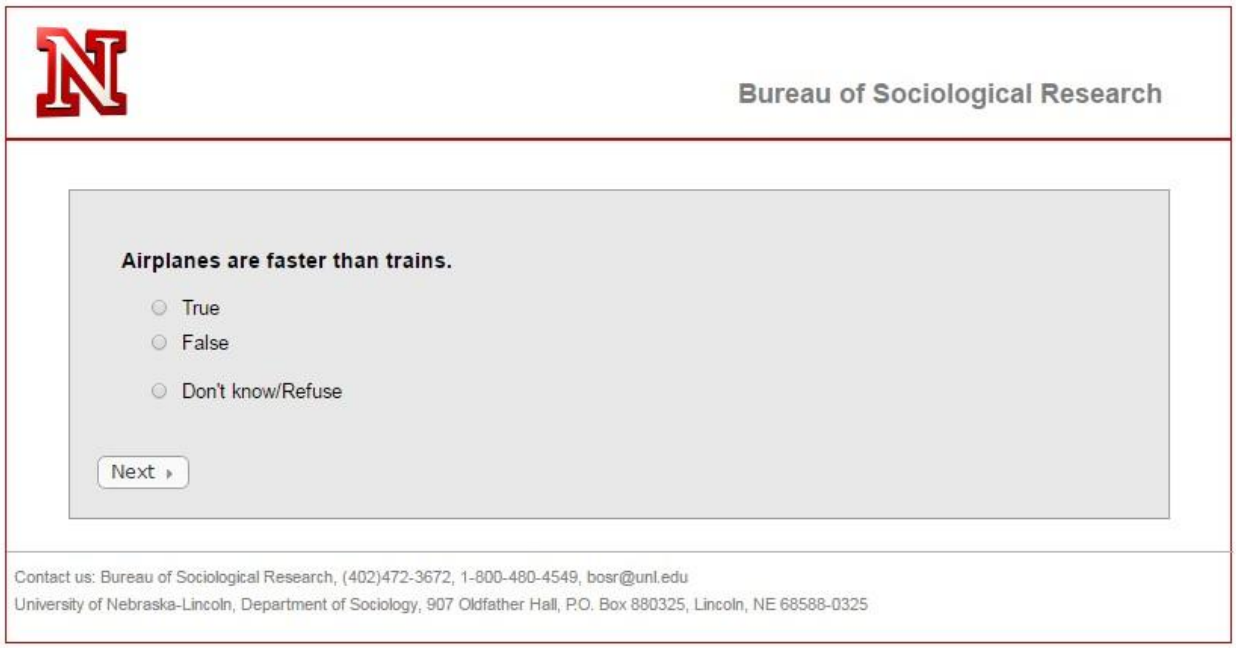
Bureau of Sociological Research
Airplanes are faster than trains.
True
False
Don't know/Refuse
Next
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Bureau of Sociological Research
The taste of sugar is sweet.
True
False
Don't know/Refuse
Next
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Bureau of Sociological Research
You can sit on a chair.
True
False
Don't know/Refuse
Next
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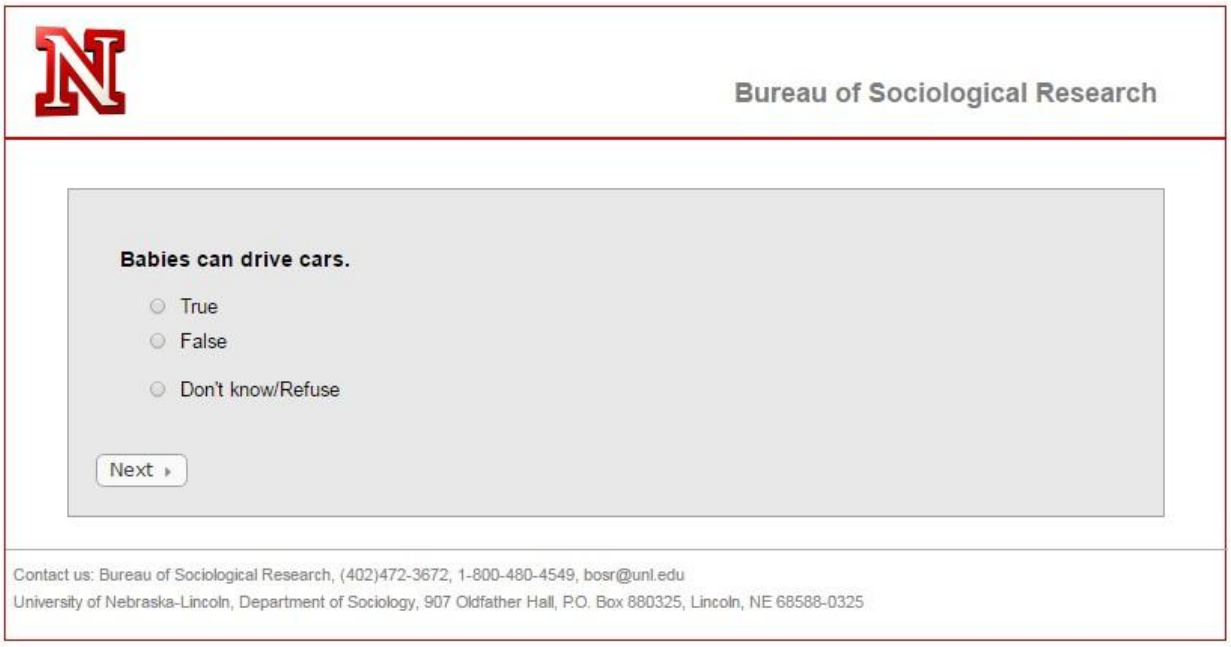
Bureau of Sociological Research
Babies can drive cars.
True
False
Don't know/Refuse
Next
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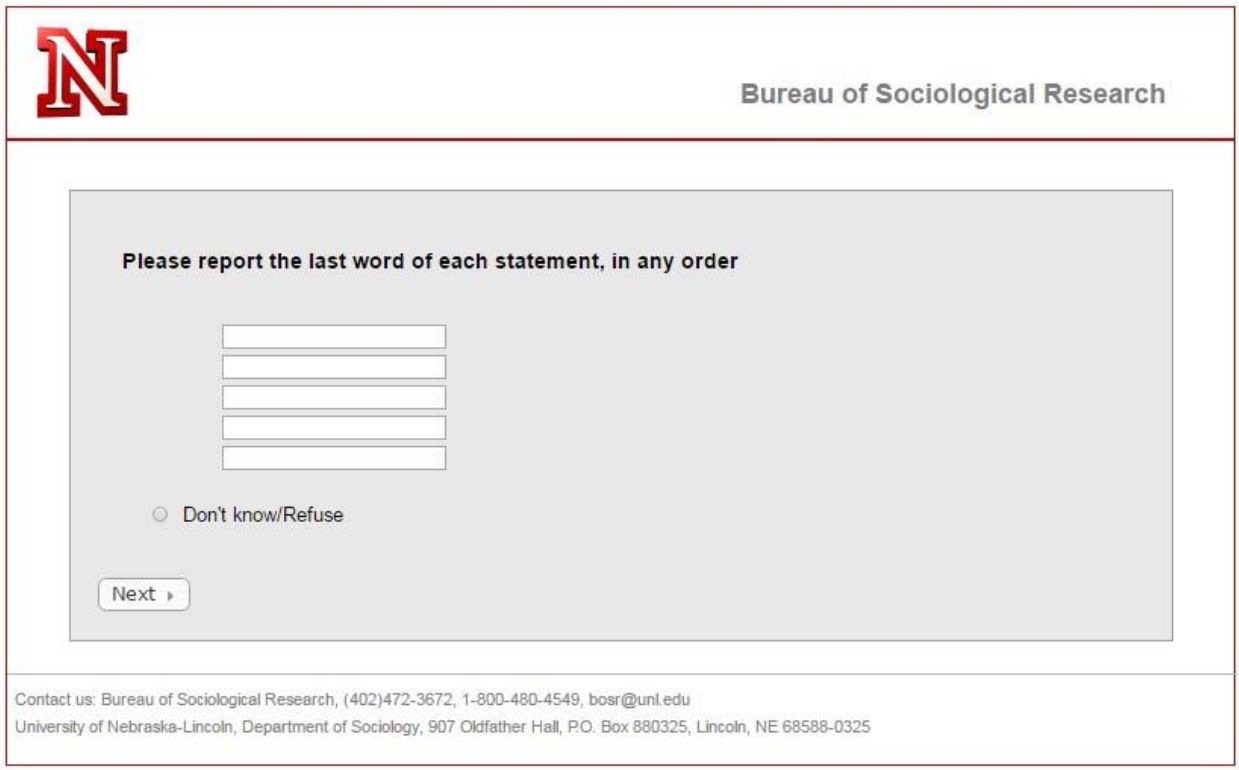
Bureau of Sociological Research
Please report the last word of each statement, in any order
Don't know/Refuse
Next
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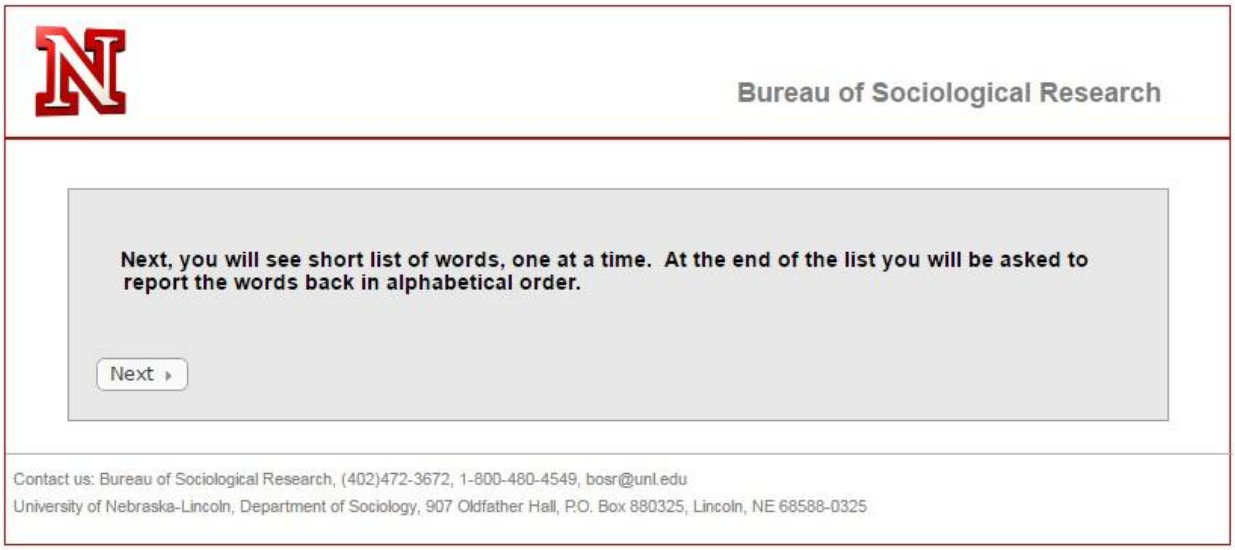
Bureau of Sociological Research
Next, you will see short list of words, one at a time. At the end of the list you will be asked to report the words back in alphabetical order.
Next
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Bureau of Sociological Research
Wife
Next
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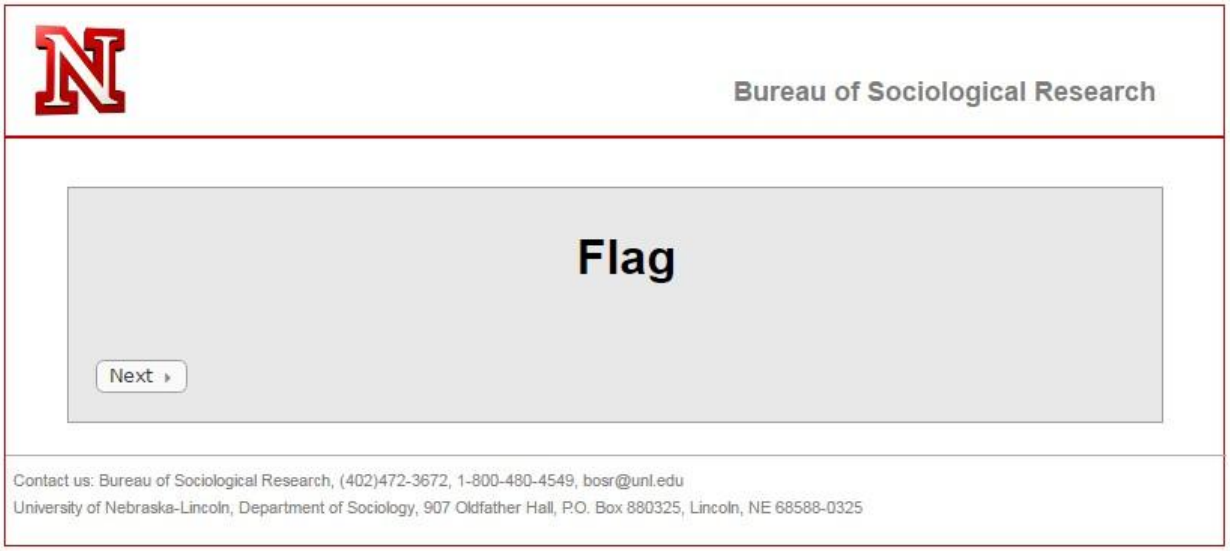
Bureau of Sociological Research
Flag
Next
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Bureau of Sociological Research
Please report the words in alphabetical order
Don't know/Refuse
Next
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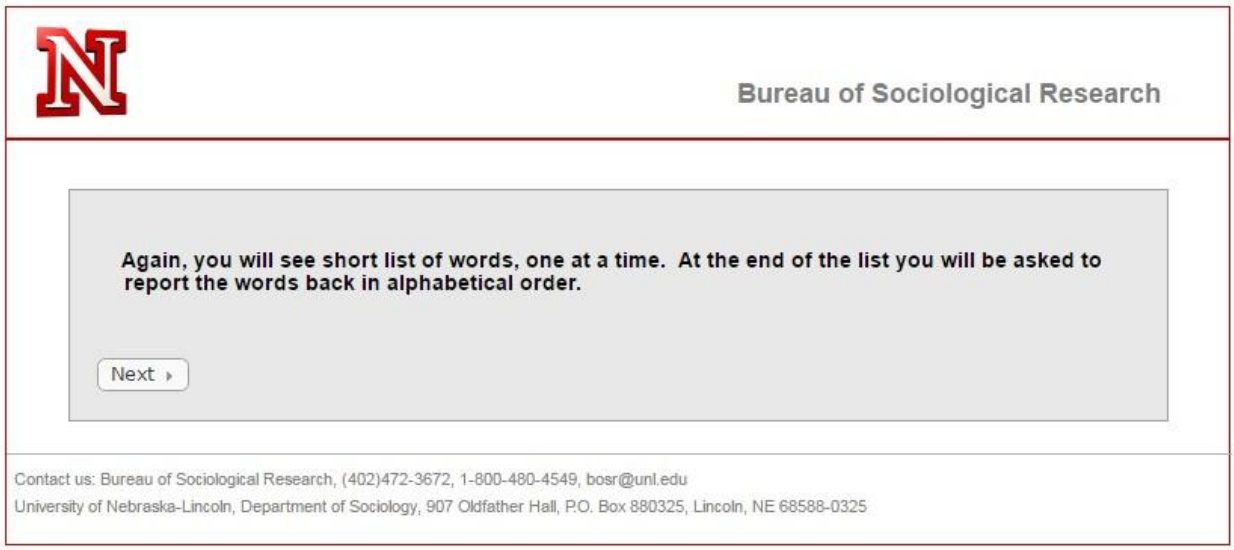
Bureau of Sociological Research
Again, you will see short list of words, one at a time. At the end of the list you will be asked to report the words back in alphabetical order.
Next
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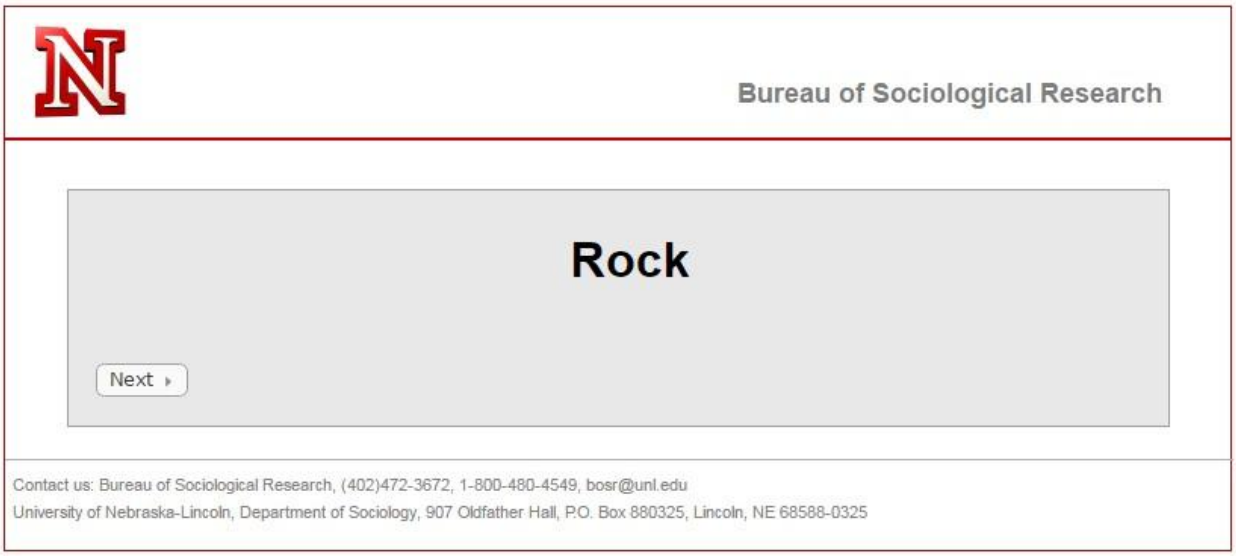
Bureau of Sociological Research
Rock
Next
Contact us: Bureau of Sociological Research, (402)472-3672, 1-800-480-4549, bosr@unl.edu
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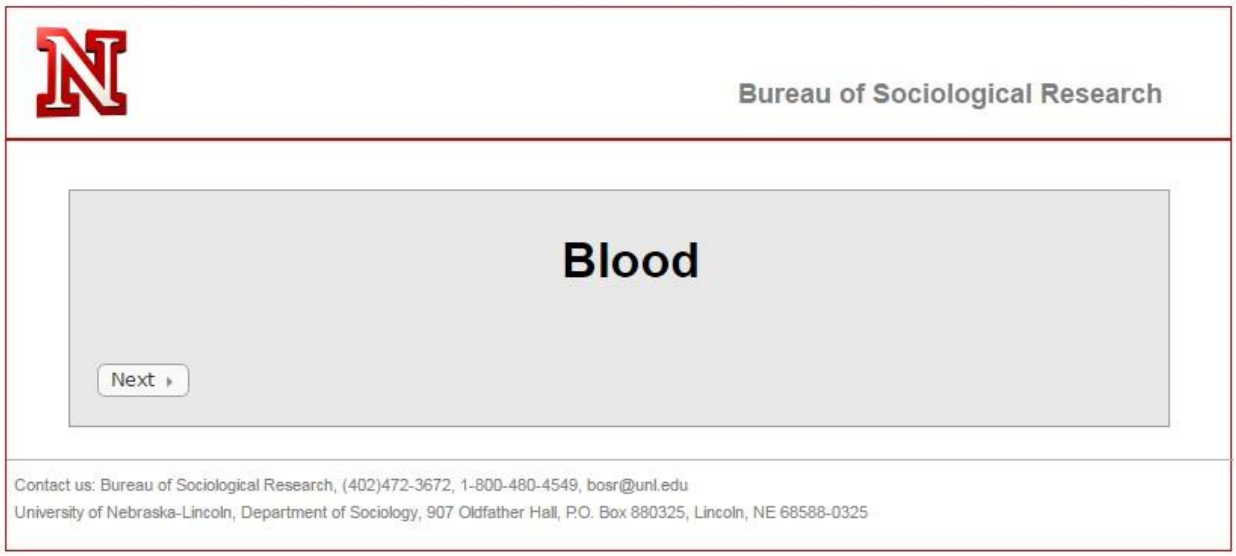
Bureau of Sociological Research
Blood
Next
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Bureau of Sociological Research
Shoes
Next
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Bureau of Sociological Research
Girl
Next
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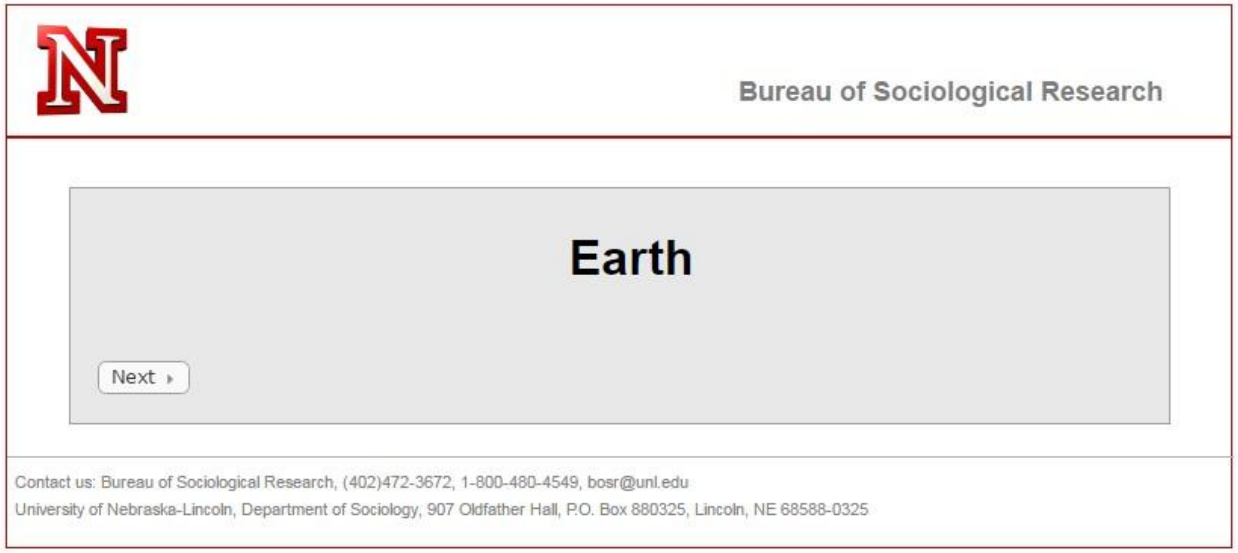
Bureau of Sociological Research
Earth
Next
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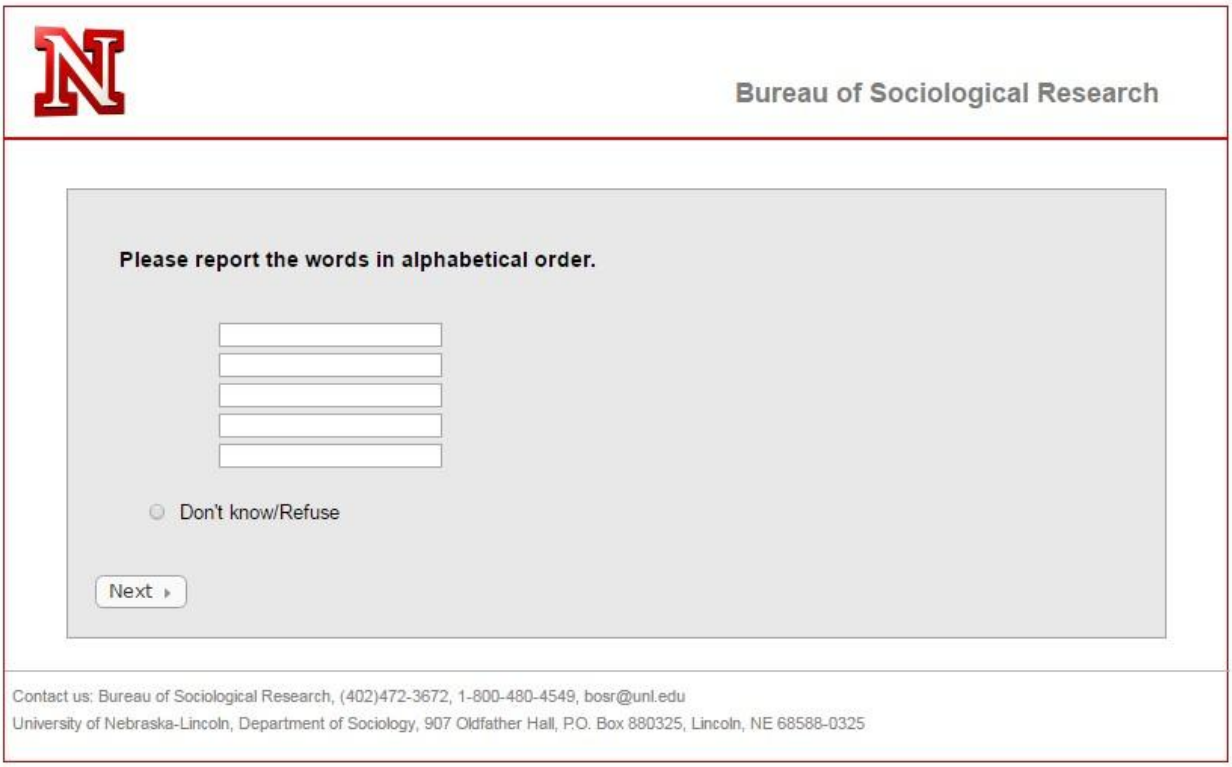
Bureau of Sociological Research
Please report the words in alphabetical order.
Don't know/Refuse
Next
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Bureau of Sociological Research
For the next questions, you are asked to subtract 7 from 100. Then you will subtract 7 from the number you arrived at and continue to subtract 7 from the previous number.
a. What is 7 subtracted from 100?
Don't know/Refuse
Next
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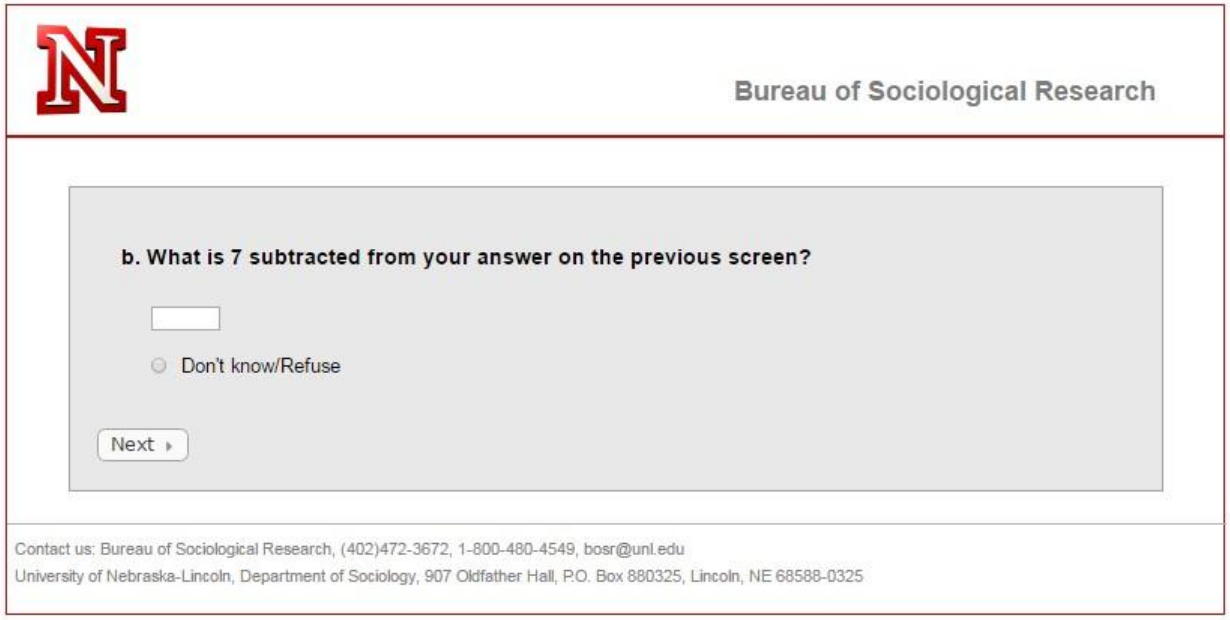
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b. What is 7 subtracted from your answer on the previous screen?
Don't know/Refuse
Next
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Bureau of Sociological Research
c. What is 7 subtracted from your answer on the previous screen?
Don't know/Refuse
Next
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d. What is 7 subtracted from your answer on the previous screen?
Don't know/Refuse
Next
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Bureau of Sociological Research
e. What is 7 subtracted from your answer on the previous screen?
Don't know/Refuse
Next
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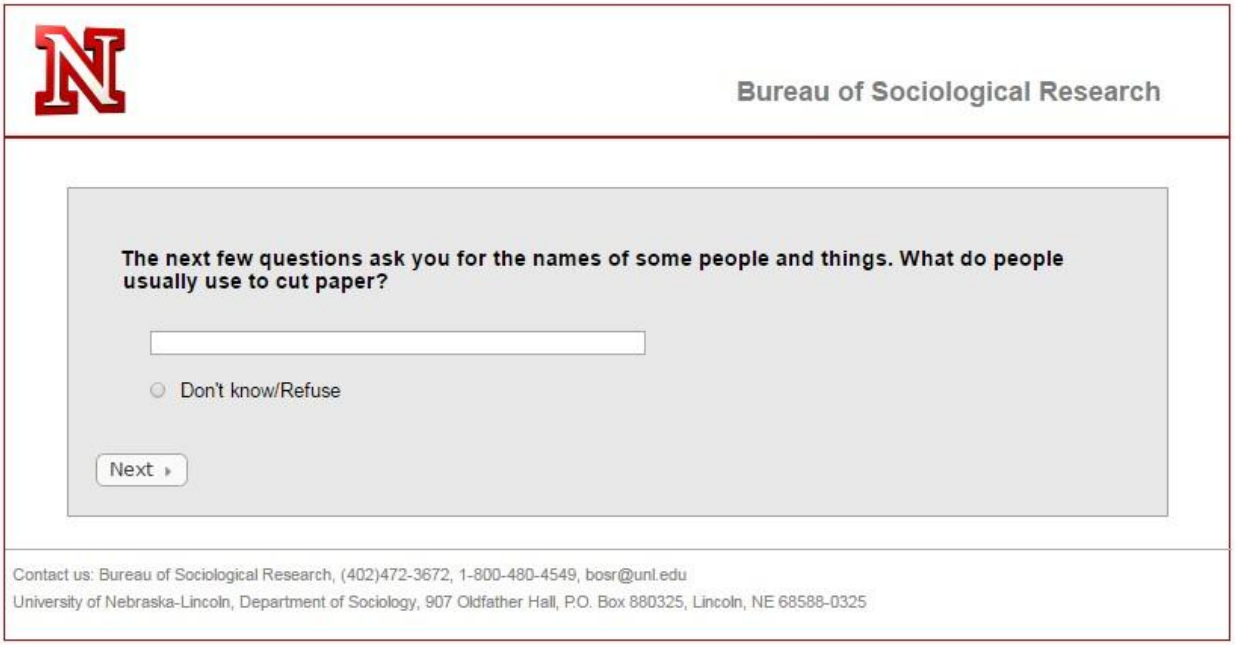
Bureau of Sociological Research
The next few questions ask you for the names of some people and things. What do people usually use to cut paper?
Don't know/Refuse
Next
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Bureau of Sociological Research
Who is the President of the United States right now?
Don't know/Refuse
Next
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Who is the Vice President of the United States right now?
Don't know/Refuse
Next
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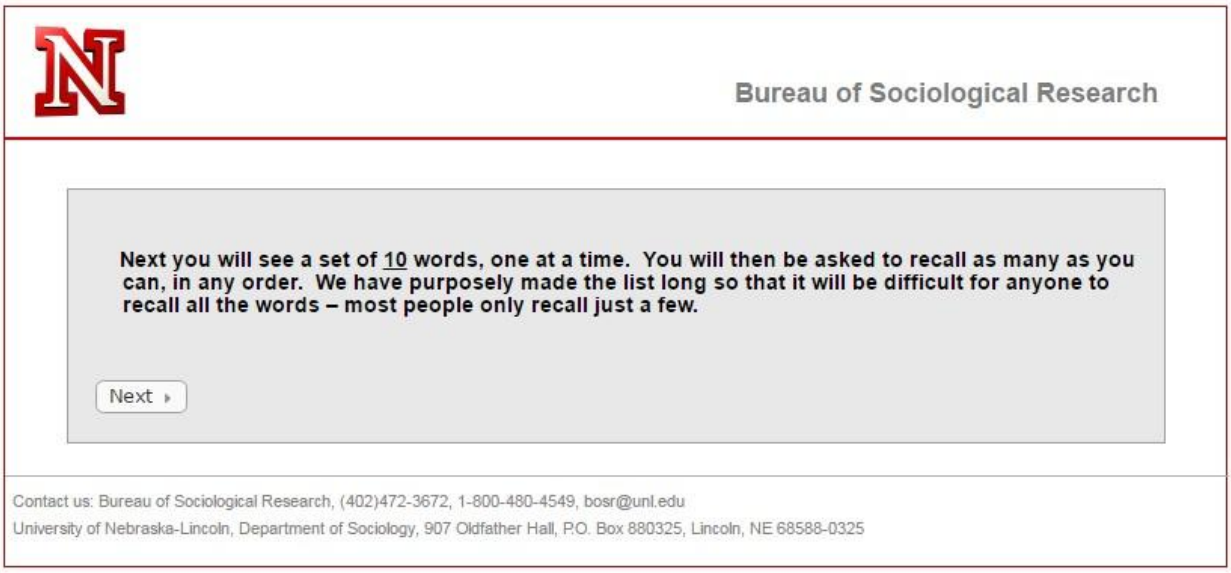
Bureau of Sociological Research
Next you will see a set of 10 words, one at a time. You will then be asked to recall as many as you can, in any order. We have purposely made the list long so that it will be difficult for anyone to recall all the words – most people only recall just a few.
Next
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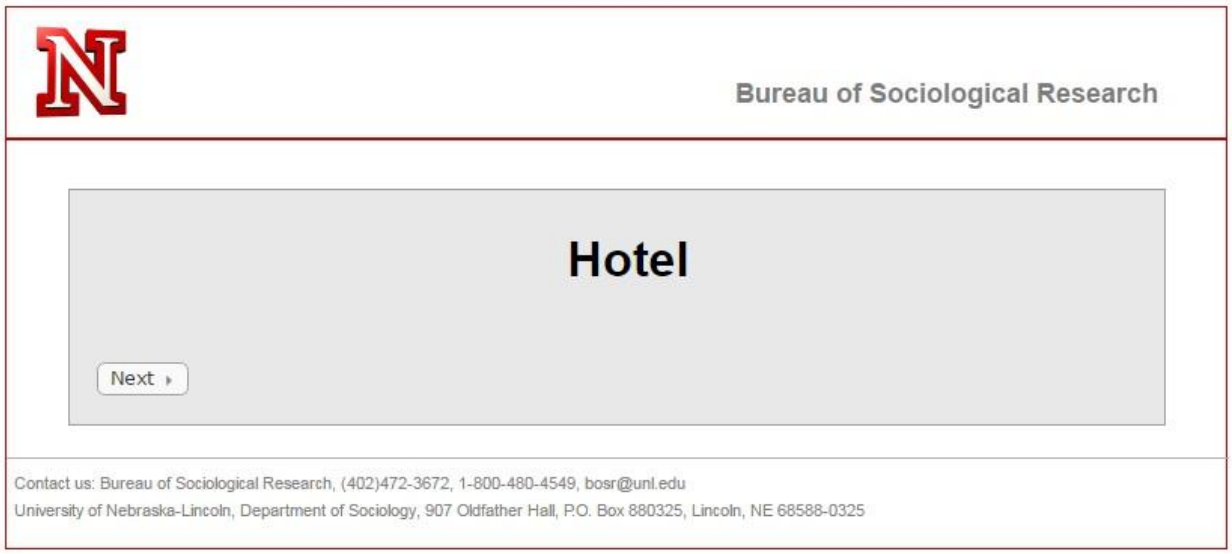
Bureau of Sociological Research
Hotel
Next
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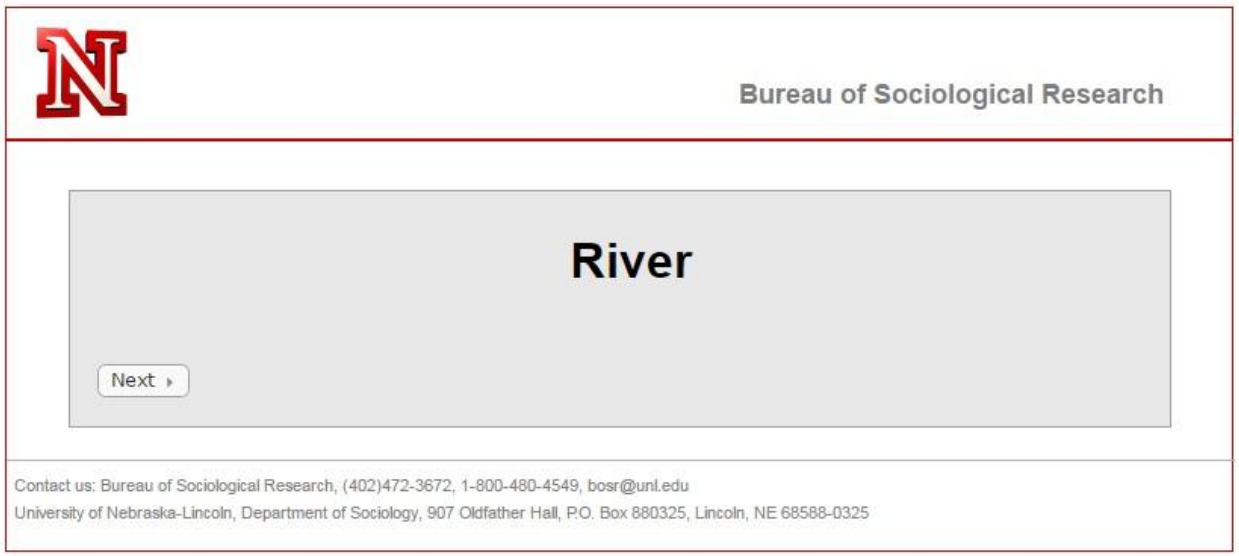
Bureau of Sociological Research
River
Next
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Bureau of Sociological Research
Tree
Next
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Bureau of Sociological Research
Skin
Next
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Bureau of Sociological Research
Gold
Next
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Bureau of Sociological Research
Market
Next
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Bureau of Sociological Research
Paper
Next
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Bureau of Sociological Research
Child
Next
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Bureau of Sociological Research
King
Next
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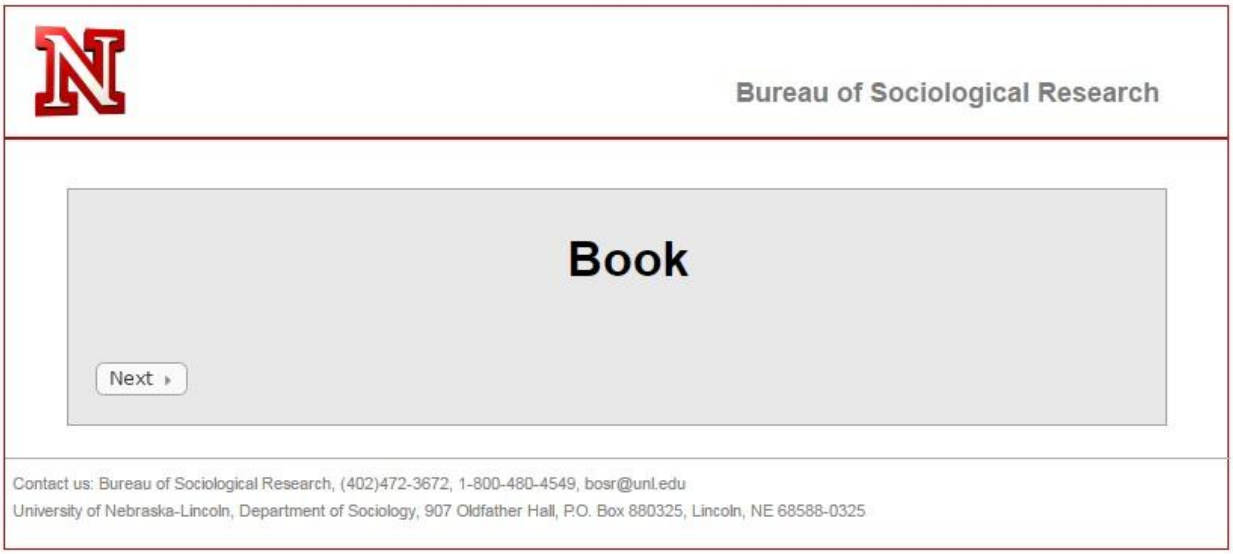
Bureau of Sociological Research
Book
Next
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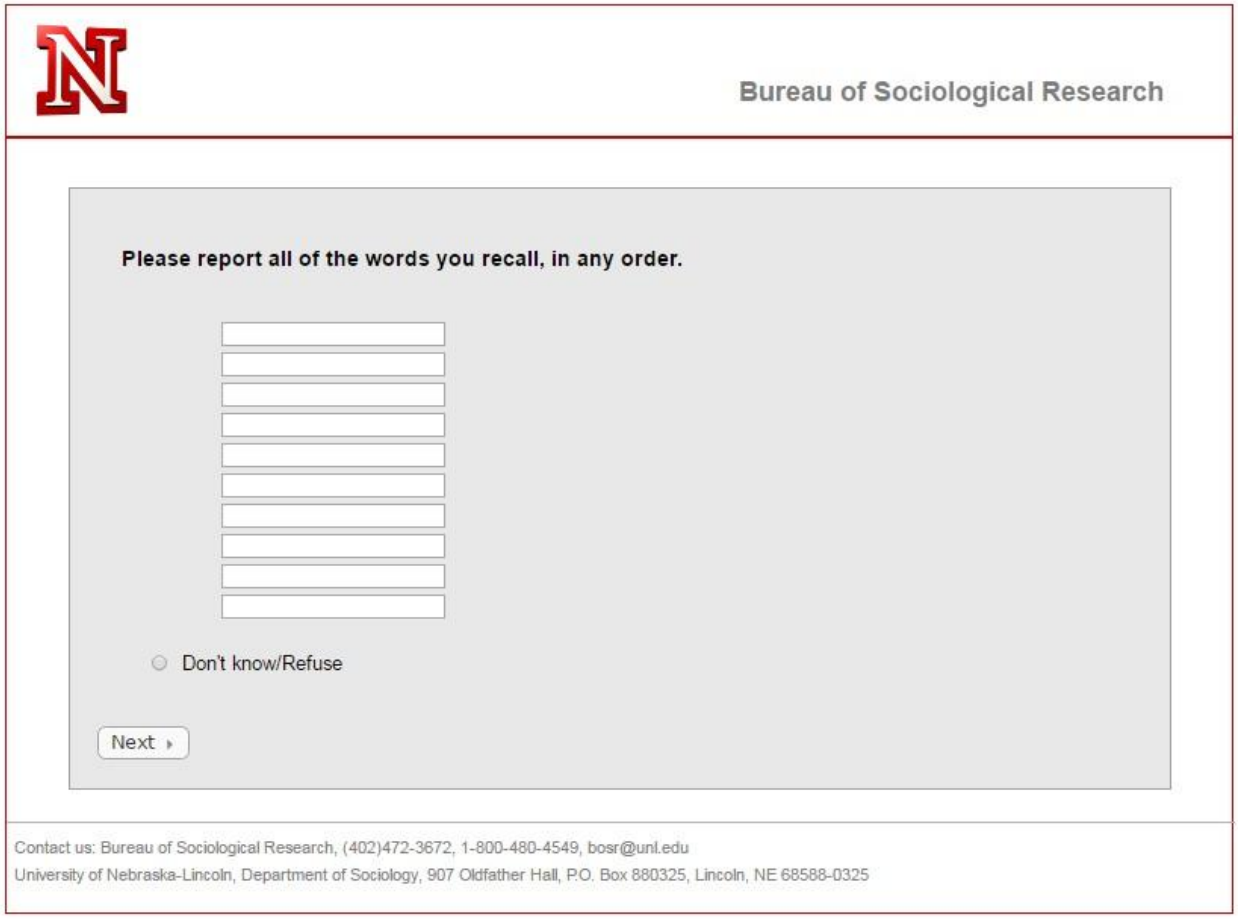
Bureau of Sociological Research
Please report all of the words you recall, in any order.
Don't know/Refuse
Next
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The following questions are for demographic purposes only.
What is your age?
Don't know/Refuse
Next
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Bureau of Sociological Research
What is your sex?
Male
Female
Other
Don't know/Refuse
Next
Contact us: Bureau of Sociological Research, (402)472-3672, 1-800-480-4549, bosr@unl.edu
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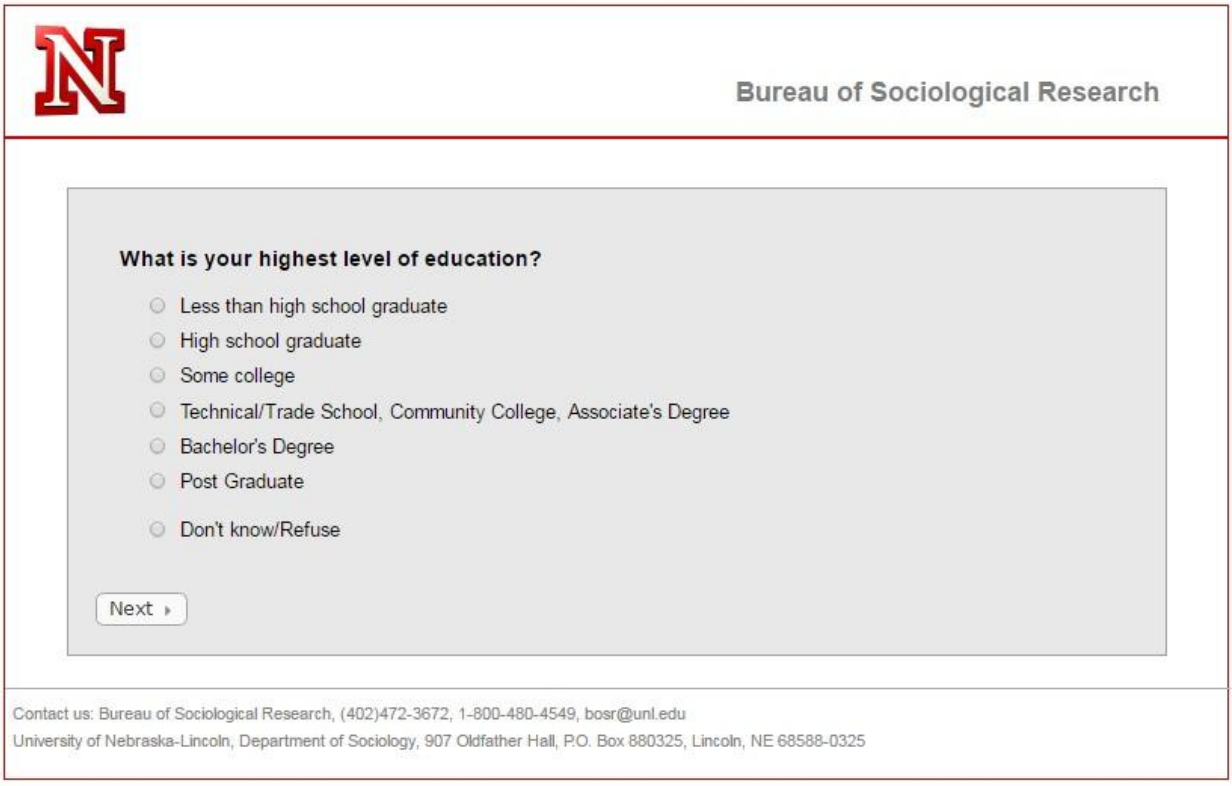
Bureau of Sociological Research
What is your highest level of education?
Less than high school graduate
High school graduate
Some college
Technical/Trade School, Community College, Associate's Degree
Bachelor's Degree
Post Graduate
Don't know/Refuse
Next
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Bureau of Sociological Research
Are you now employed full-time, part-time, not employed, retired, a student, or something else?
Employed full-time
Employed part-time
Not employed
Retired
Student
Other
Don't know/Refuse
Next
Contact us: Bureau of Sociological Research, (402)472-3672, 1-800-480-4549, bosr@unl.edu
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Bureau of Sociological Research
Thank you!
Comments?
Submit
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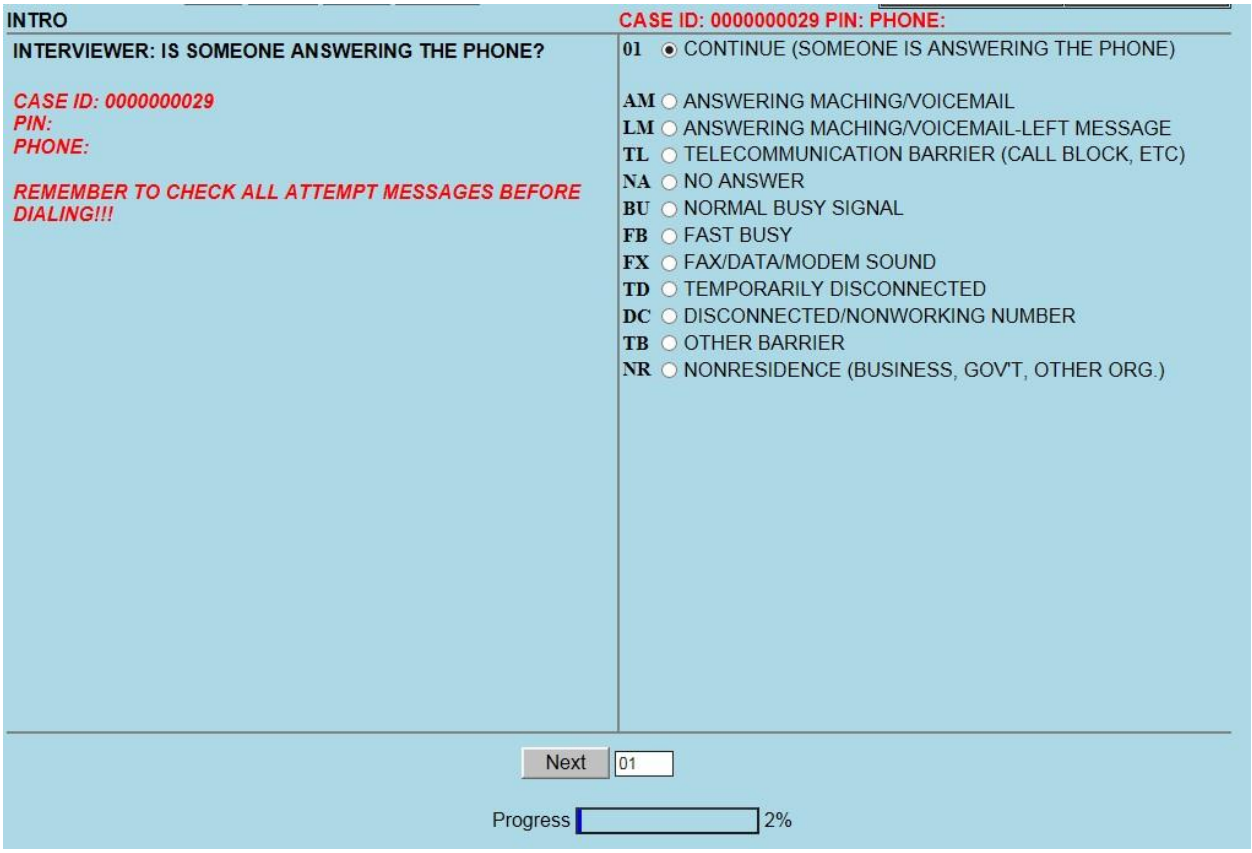
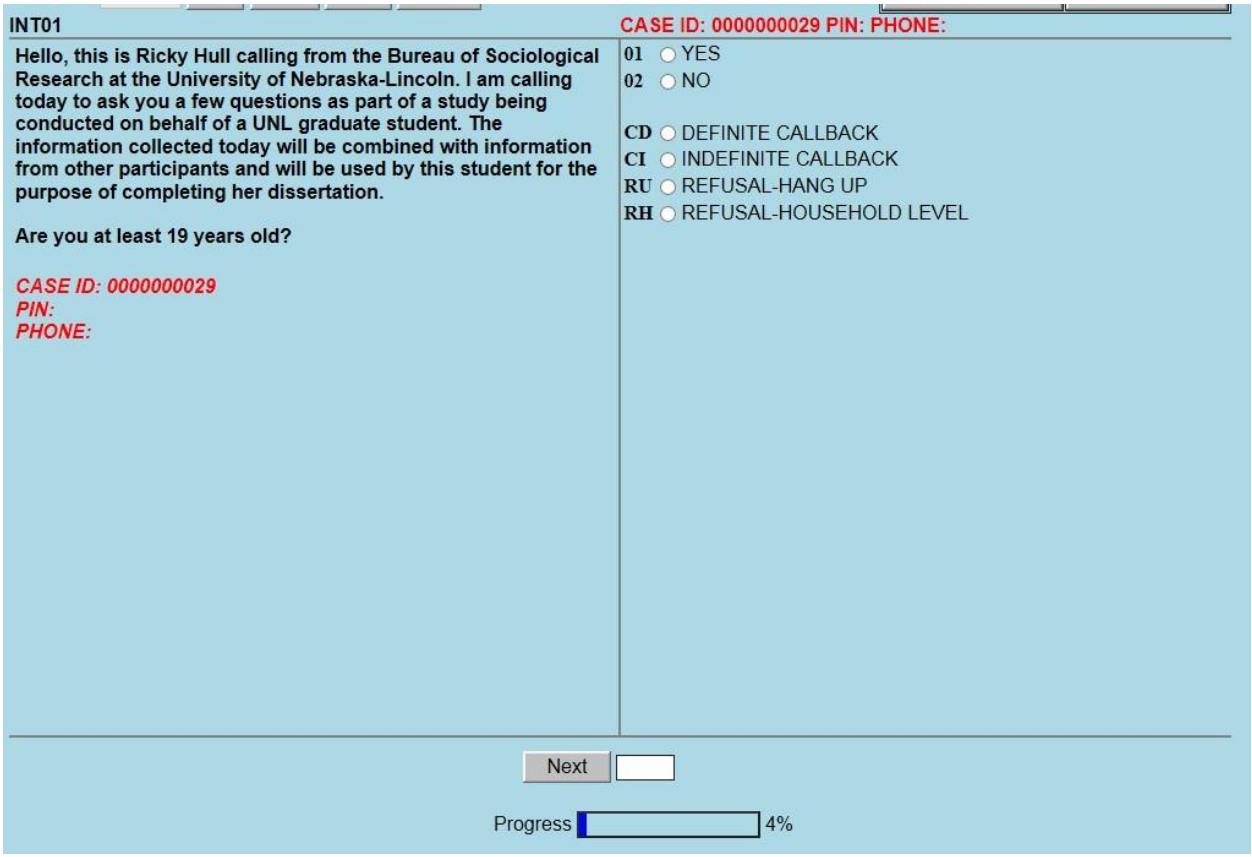
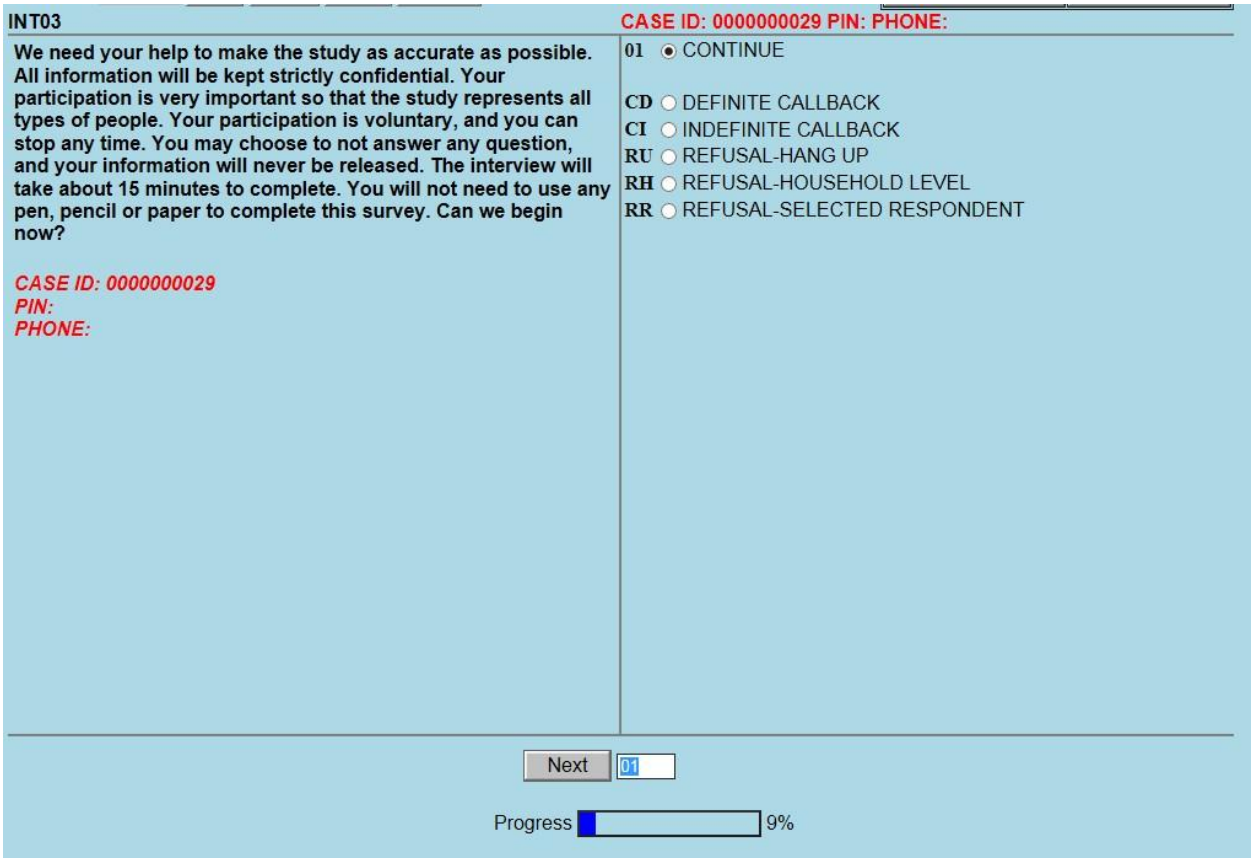
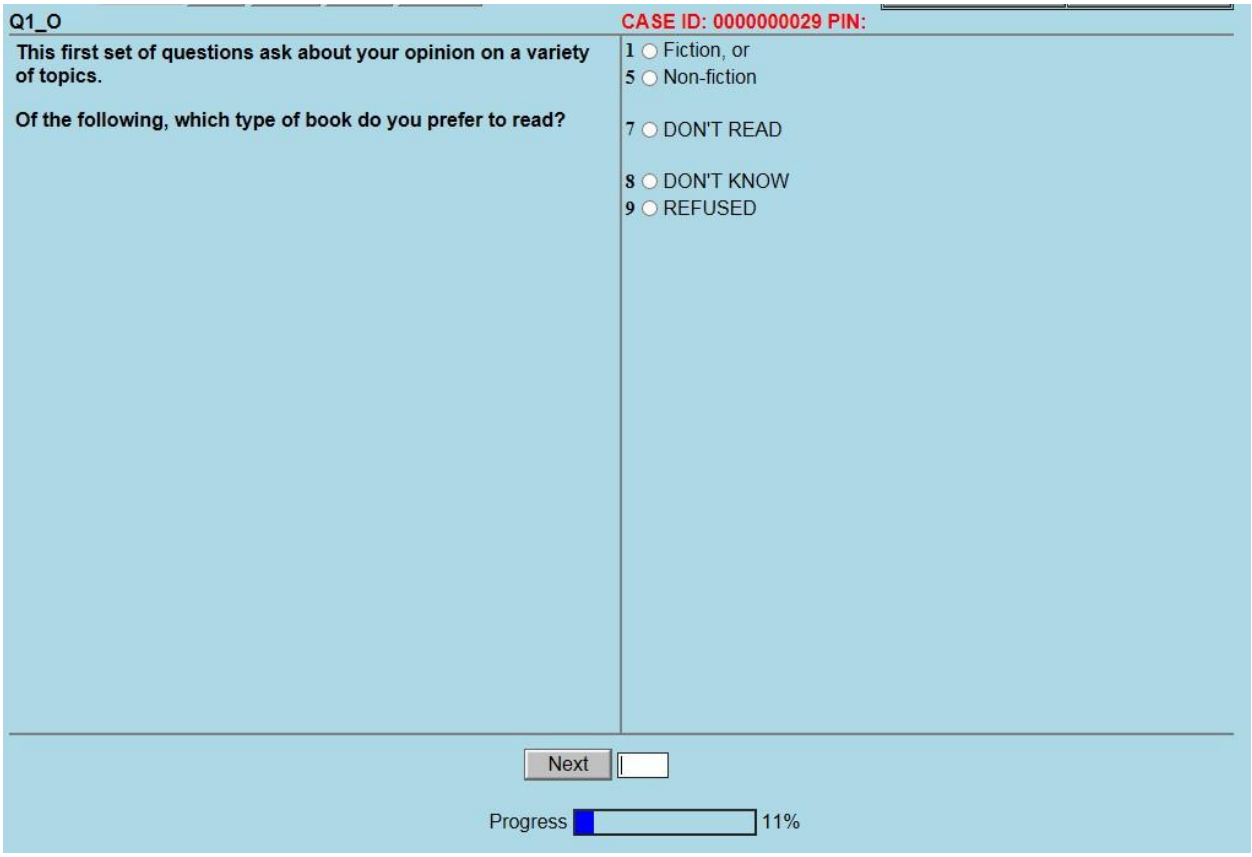
Appendix A2: Phone Questionnaire

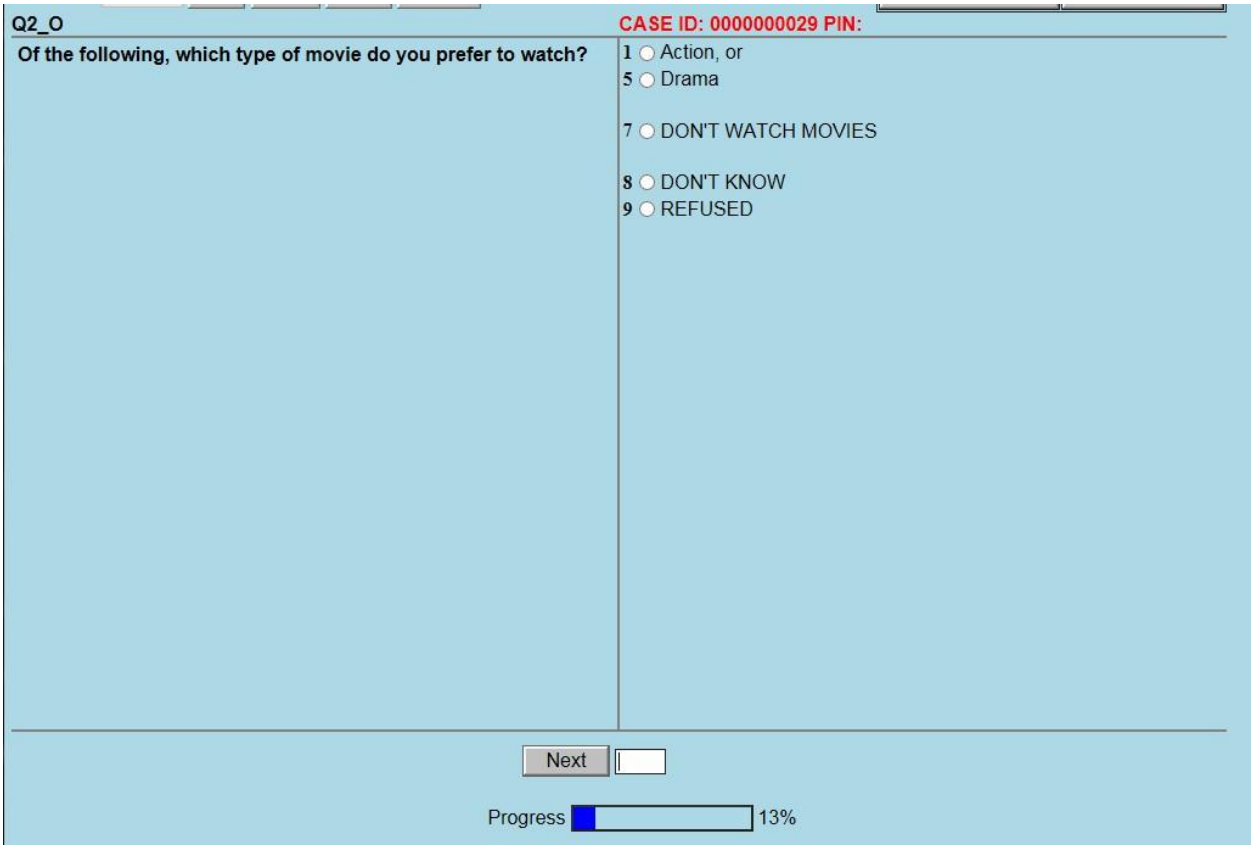
Presented here is the questionnaire as it appears in Version 1. See Appendix A7 for differences between versions.

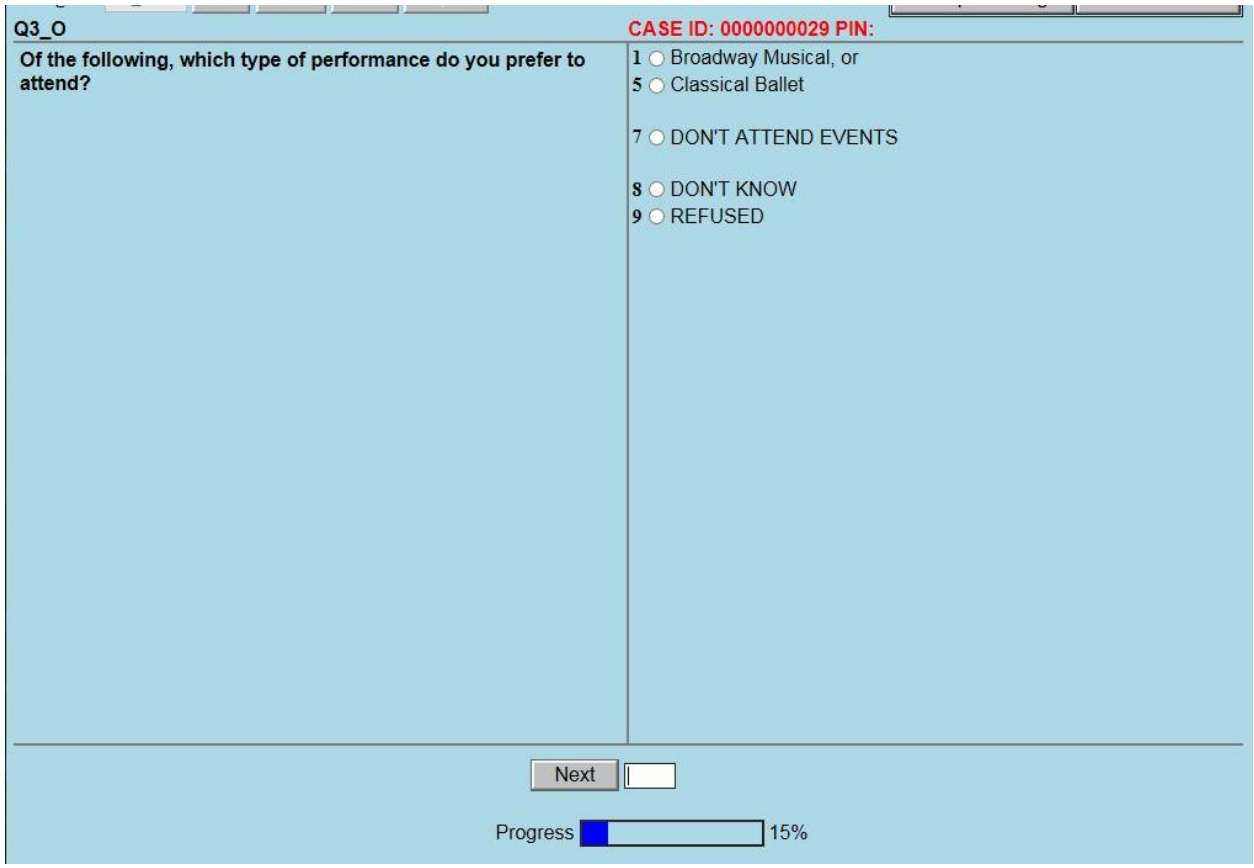


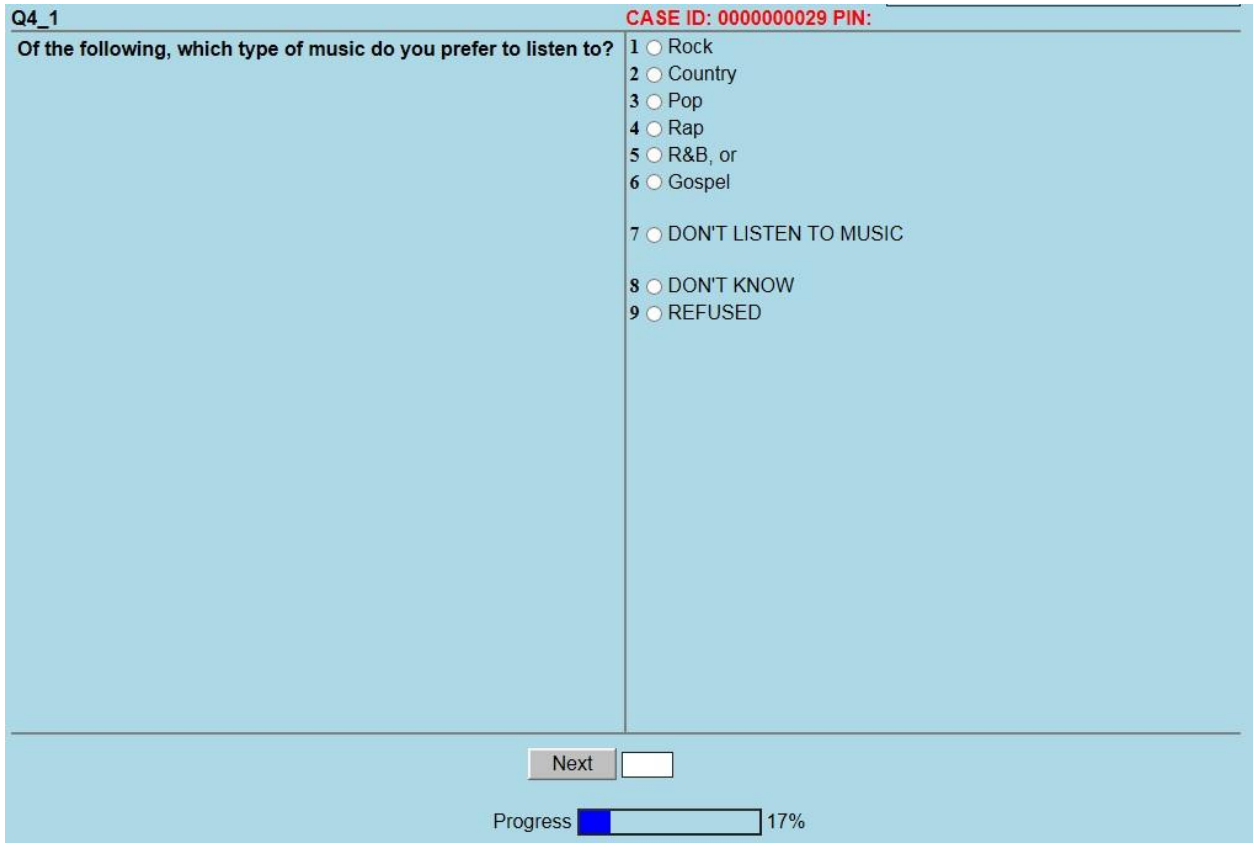

INT01
CASE ID: 0000000029 PIN: PHONE:
Hello, this is Ricky Hull calling from the Bureau of Sociological Research at the University of Nebraska-Lincoln. I am calling today to ask you a few questions as part of a study being conducted on behalf of a UNL graduate student. The information collected today will be combined with information from other participants and will be used by this student for the purpose of completing her dissertation.
Are you at least 19 years old?
CASE ID: 0000000029
PIN:
PHONE:
01 YES
02 NO
CD DEFINITE CALLBACK
CI INDEFINITE CALLBACK
RU REFUSAL-HANG UP
RH REFUSAL-HOUSEHOLD LEVEL
Next
Progress
4%


INT03
CASE ID: 0000000029 PIN: PHONE:
We need your help to make the study as accurate as possible. All information will be kept strictly confidential. Your participation is very important so that the study represents all types of people. Your participation is voluntary, and you can stop any time. You may choose to not answer any question, and your information will never be released. The interview will take about 15 minutes to complete. You will not need to use any pen, pencil or paper to complete this survey. Can we begin now?
CASE ID: 0000000029
PIN:
PHONE:
01 CONTINUE
CD DEFINITE CALLBACK
CI INDEFINITE CALLBACK
RU REFUSAL-HANG UP
RH REFUSAL-HOUSEHOLD LEVEL
RR REFUSAL-SELECTED RESPONDENT
Next
01
Progress
9%


Q1_O
CASE ID: 0000000029 PIN:
This first set of questions ask about your opinion on a variety of topics.
Of the following, which type of book do you prefer to read?
1 Fiction, or
5 Non-fiction
7 DON'T READ
8 DON'T KNOW
9 REFUSED
Next
Progress
11%


Q2_O
CASE ID: 0000000029 PIN:
Of the following, which type of movie do you prefer to watch?
1 Action, or
5 Drama
7 DON'T WATCH MOVIES
8 DON'T KNOW
9 REFUSED
Next
Progress
13%


Q3_O
CASE ID: 0000000029 PIN:
Of the following, which type of performance do you prefer to attend?
1 Broadway Musical, or
5 Classical Ballet
7 DON'T ATTEND EVENTS
8 DON'T KNOW
9 REFUSED
Next
Progress
15%


Q4_1
CASE ID: 0000000029 PIN:
Of the following, which type of music do you prefer to listen to?
1 Rock
2 Country
3 Pop
4 Rap
5 R&B, or
6 Gospel
7 DON'T LISTEN TO MUSIC
8 DON'T KNOW
9 REFUSED
Next
Progress
17%

Q5_1 CASE ID: 0000000029 PIN:

Of the following, which type of sporting event do you prefer to watch?

This can be either in person or on TV.

1 ○ Basketball
2 ○ Soccer
3 ○ Baseball
4 ○ Hockey
5 ○ Golf, or
6 ○ Volleyball

7 ○ DON'T WATCH SPORTS

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 19%

Q6_1 CASE ID: 0000000029 PIN:

Of the following, which type of attraction do you prefer to visit?

1 ○ Art Museum
2 ○ Amusement Park
3 ○ Historical Monument
4 ○ State Capitol Building
5 ○ Science Museum, or
6 ○ National Park

7 ○ DON'T VISIT ATTRACTIONS

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 21%

Q7_O CASE ID: 0000000029 PIN:

Taken altogether, how would you say things are these days: would you say that you are very happy, somewhat happy, or not too happy?

1 ○ Very happy
2 ○ Somewhat happy
3 ○ Not too happy

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 23%

Q8_O CASE ID: 0000000029 PIN:

Taking things all together, how would you describe your relationship with your intimate partner: would you say that in your relationship with your intimate partner you are very happy, somewhat happy, or not too happy?

1 ○ Very happy
2 ○ Somewhat happy
3 ○ Not too happy

7 ○ NO INTIMATE PARTNER

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 26%

Q9_O CASE ID: 0000000029 PIN:

Do you believe that workers and unions have the right to strike when wages and working conditions don't suit them?

1 ○ YES
5 ○ NO

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 28%

Q10_O CASE ID: 0000000029 PIN:

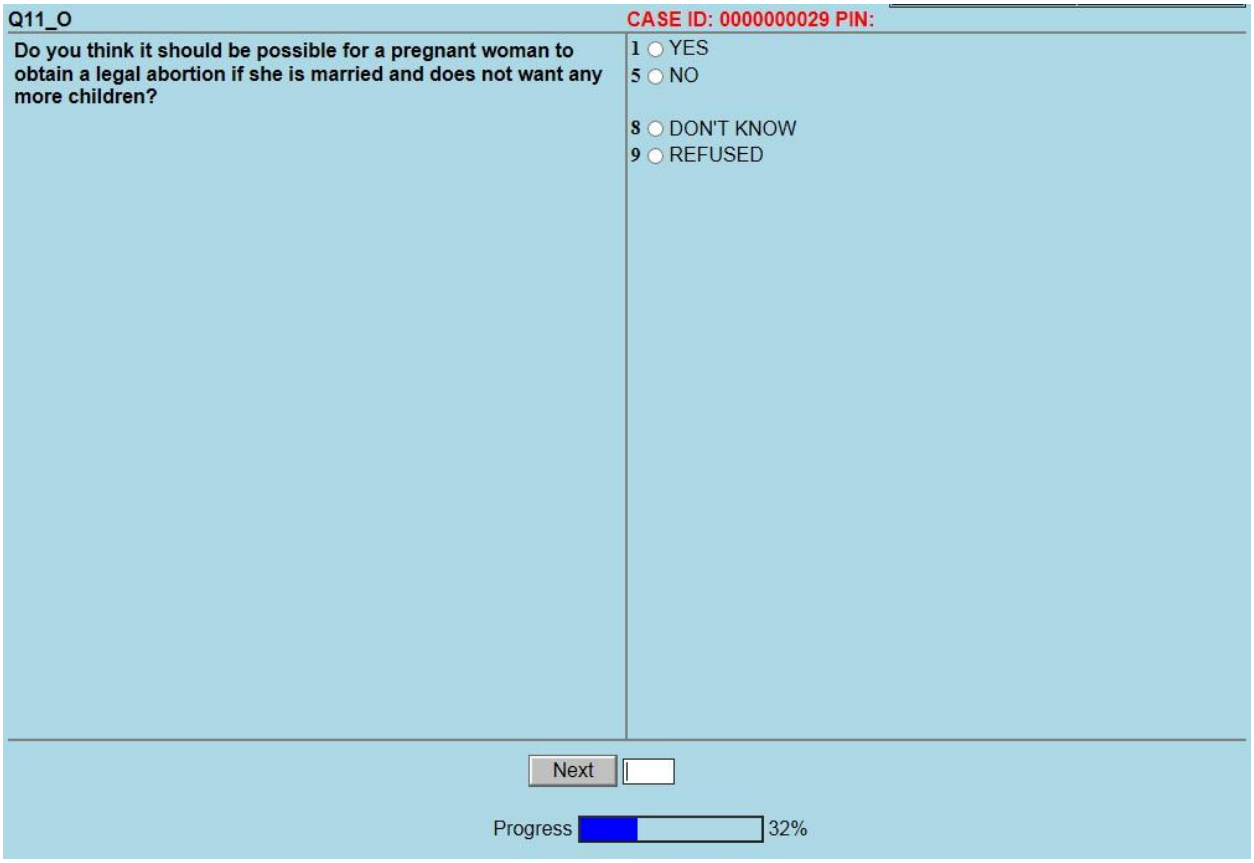
Do you believe that businessmen have a right to shut down their factories and stores when labor conditions and profits don't suit them?

1 ○ YES
5 ○ NO

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 30%



Q11_O

CASE ID: 0000000029 PIN:

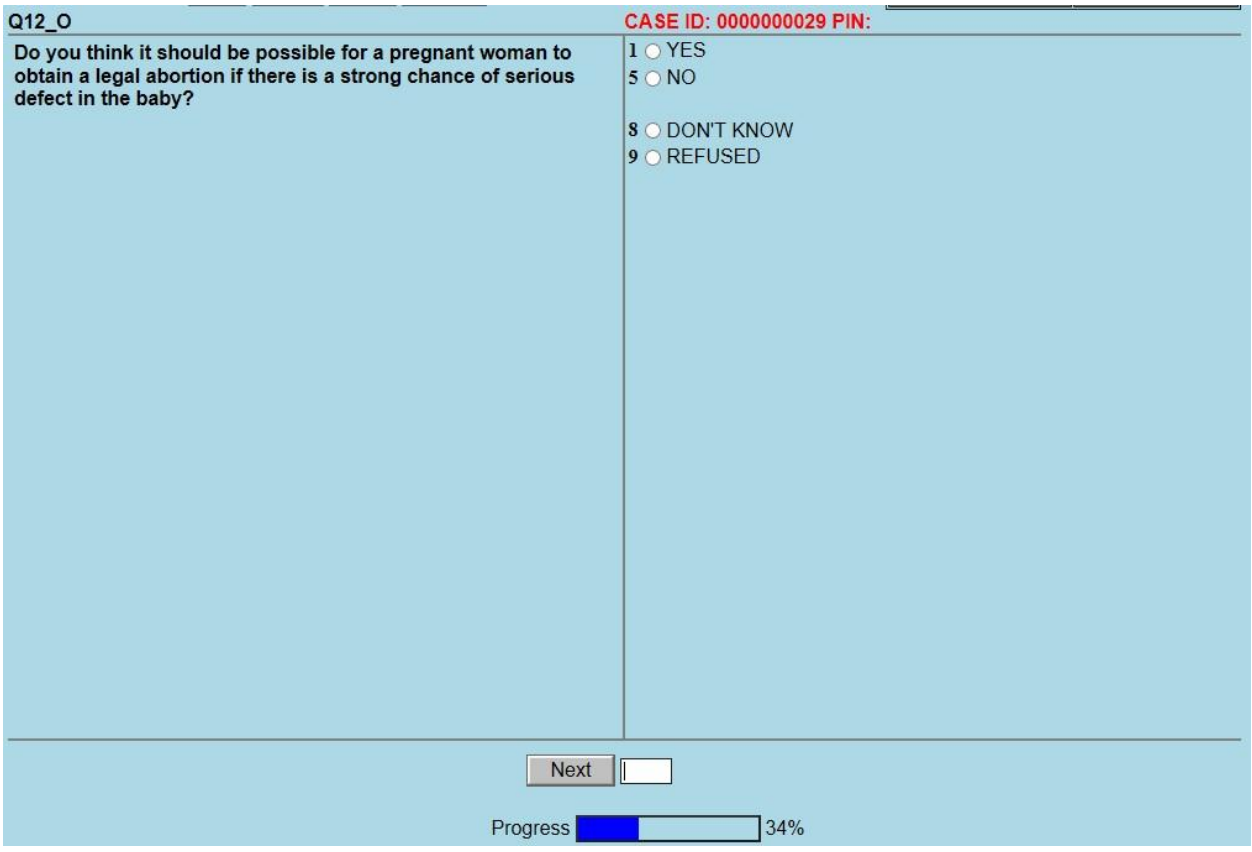
Do you think it should be possible for a pregnant woman to obtain a legal abortion if she is married and does not want any more children?

1 ○ YES
5 ○ NO

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 32%



Q12_O

CASE ID: 0000000029 PIN:

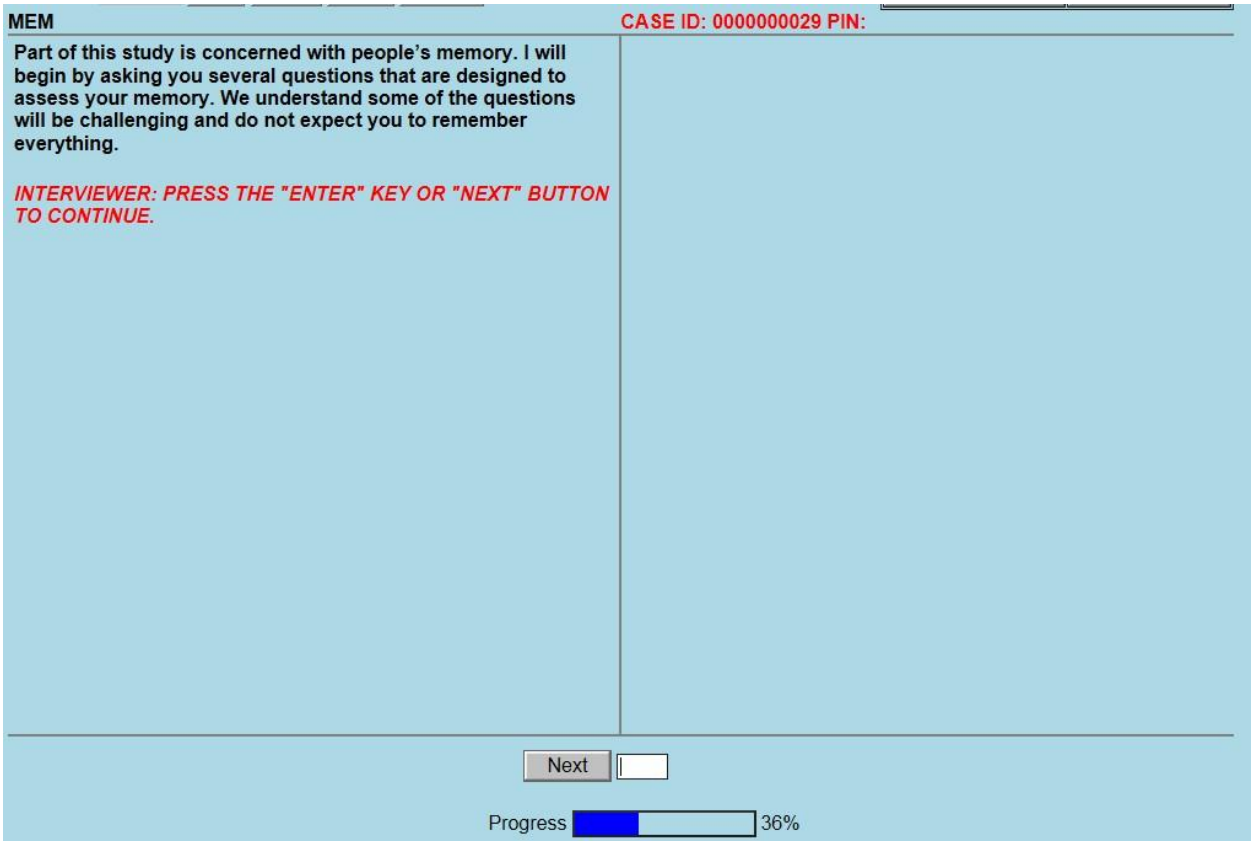
Do you think it should be possible for a pregnant woman to obtain a legal abortion if there is a strong chance of serious defect in the baby?

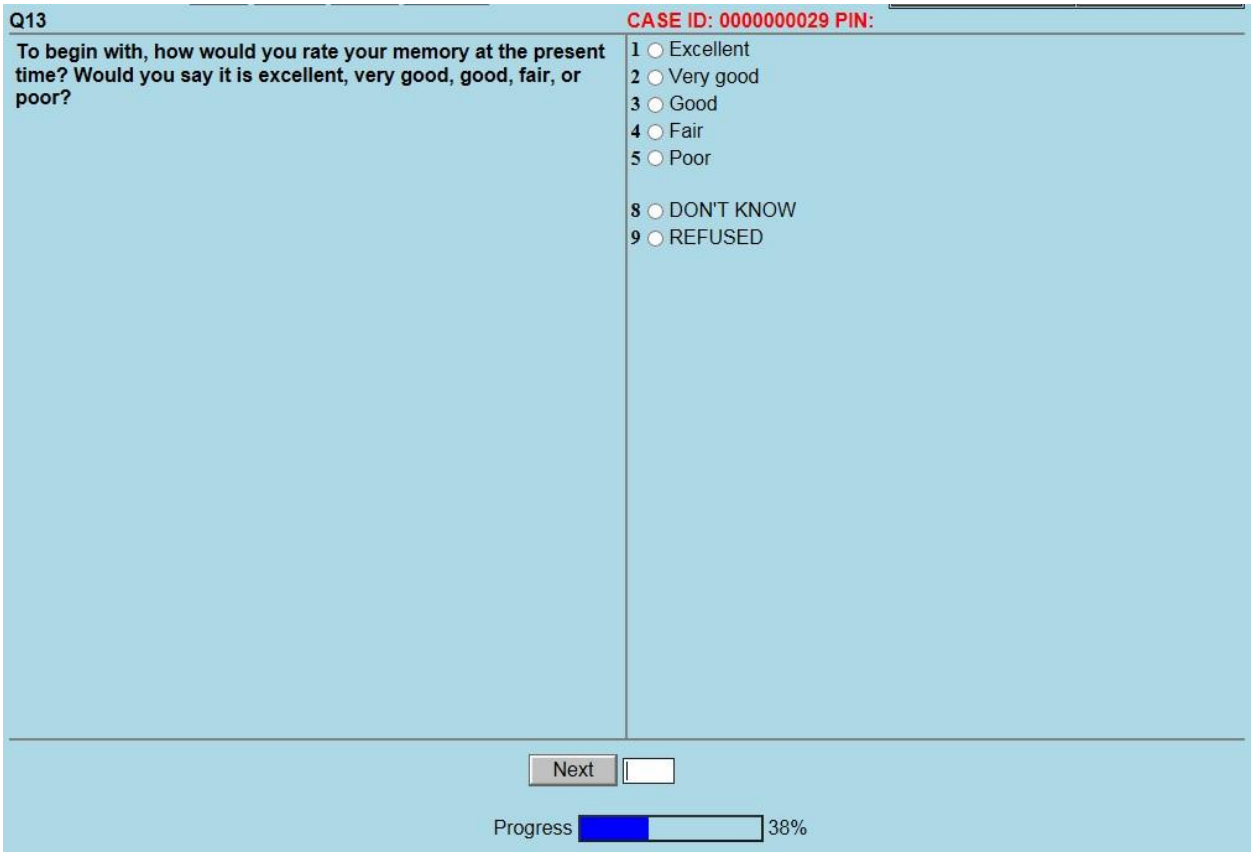
1 ○ YES
5 ○ NO

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 34%


MEM
CASE ID: 0000000029 PIN:
Part of this study is concerned with people's memory. I will begin by asking you several questions that are designed to assess your memory. We understand some of the questions will be challenging and do not expect you to remember everything.
INTERVIEWER: PRESS THE "ENTER" KEY OR "NEXT" BUTTON TO CONTINUE.
Next
Progress
36%


Q13
CASE ID: 0000000029 PIN:
To begin with, how would you rate your memory at the present time? Would you say it is excellent, very good, good, fair, or poor?
1 Excellent
2 Very good
3 Good
4 Fair
5 Poor
8 DON'T KNOW
9 REFUSED
Next
Progress
38%

Q14A CASE ID: 0000000029 PIN:

Next, I am going to read a set of short statements to you. Please indicate for each statement whether it is True or False. At the end I will ask you to repeat the final word of each statement. Is this clear?

Let's begin...

True or False? A clock is used to tell time.

1 ○ TRUE
5 ○ FALSE

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 40%

Q14B CASE ID: 0000000029 PIN:

True or False? Grass is the color blue.

1 ○ TRUE
5 ○ FALSE

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 43%

Q14C	CASE ID: 0000000029 PIN:
True or False? Birds fly in the sky.	**1** ○ TRUE **5** ○ FALSE **8** ○ DON'T KNOW **9** ○ REFUSED

Next

Progress 45%

Q14D	CASE ID: 0000000029 PIN:
Now, please tell me the last word of each statement, in any order. ***INTERVIEWER: CHECK ONLY THE CORRECT WORDS.***	**1** ☐ TIME **2** ☐ BLUE **3** ☐ SKY **5** ☐ R DID NOT STATE ANY CORRECT WORDS **8** ☐ DON'T KNOW **9** ☐ REFUSED

Next

Progress 47%

Q15A CASE ID: 0000000029 PIN:

Now I will read another set of statements. Again please indicate for each statement whether it is True or False. At the end of the set I will ask you to repeat the final word of each statement.

Let's begin.

True or False? Fish walk on land.

1 ○ TRUE
5 ○ FALSE

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 49%

Q15B CASE ID: 0000000029 PIN:

True or False? Airplanes are faster than trains.

1 ○ TRUE
5 ○ FALSE

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 51%

Q15C	CASE ID: 0000000029 PIN:
True or False? The taste of sugar is sweet.	**1** ○ TRUE **5** ○ FALSE **8** ○ DON'T KNOW **9** ○ REFUSED

Next

Progress 53%

Q15D	CASE ID: 0000000029 PIN:
True or False? You can sit on a chair.	**1** ○ TRUE **5** ○ FALSE **8** ○ DON'T KNOW **9** ○ REFUSED

Next

Progress 55%

Q15E	CASE ID: 0000000029 PIN:
True or False? Babies can drive cars.	1 ○ TRUE 5 ○ FALSE 8 ○ DON'T KNOW 9 ○ REFUSED

Next

Progress 57%

Q15F	CASE ID: 0000000029 PIN:
Now, please tell me the last word of each statement, in any order. ***INTERVIEWER: CHECK ONLY THE CORRECT WORDS.***	1 ☐ LAND 2 ☐ TRAINS 3 ☐ SWEET 4 ☐ CHAIR 5 ☐ CARS 7 ☐ R DID NOT STATE ANY CORRECT WORDS 8 ☐ DON'T KNOW 9 ☐ REFUSED

Next

Progress 60%

Q16A CASE ID: 0000000029 PIN:

Next, I will read you a short list of words. Please listen carefully as I read the set of words because I cannot repeat them. When I finish, I will ask you to repeat the words back to me in alphabetical order. Is this clear?

The words are…

Home
Wife, and
Flag

Please recall the words in alphabetical order.

INTERVIEWER: PLEASE INDICATE WHICH WORD WAS SAID 1ST, 2ND, AND 3RD. SELECT "OTHER" IF THE RESPONDENT GIVES A WORD NOT ON THE LIST.

FOR "DON'T KNOW" OR "REFUSED", SELECT THAT OPTION ON ALL LINES.

	FLAG	HOME	WIFE	OTHER	DON'T KNOW	REFUSED
1ST:	○	○	○	○	○	○
2ND:	○	○	○	○	○	○
3RD:	○	○	○	○	○	○

Next

Progress 62%

Q17A CASE ID: 0000000029 PIN:

Again, I will read you a short list of words and ask you to repeat them in alphabetical order? Please listen carefully as I read the set of words because I cannot repeat them.

The words are…

Rock
Blood
Shoes
Girl, and
Earth

Please recall the words in alphabetical order.

INTERVIEWER: PLEASE INDICATE WHICH WORD WAS SAID 1ST, 2ND, 3RD, 4TH, AND 5TH. SELECT "OTHER" IF THE RESPONDENT GIVES A WORD NOT ON THE LIST.

FOR "DON'T KNOW" OR "REFUSED", SELECT THAT OPTION ON ALL LINES.

	BLOOD	EARTH	GIRL	ROCK	SHOES	OTHER	DON'T KNOW	REFUSED
1ST:	○	○	○	○	○	○	○	○
2ND:	○	○	○	○	○	○	○	○
3RD:	○	○	○	○	○	○	○	○
4TH:	○	○	○	○	○	○	○	○
5TH:	○	○	○	○	○	○	○	○

Next

Progress 64%

Q18A CASE ID: 0000000029 PIN:

For the next question, I will ask you to subtract 7 from 100. Then you will subtract 7 from the number you arrived at and continue to subtract 7 from the previous number. Is this clear?

What is 7 subtracted from 100?

888 ○ DON'T KNOW
999 ○ REFUSED

Next

Progress 66%

Q18B CASE ID: 0000000029 PIN:

And 7 subtracted from that number?

888 ○ DON'T KNOW
999 ○ REFUSED

Next

Progress 68%

Q18C CASE ID: 0000000029 PIN:

And 7 subtracted from that?

888 ○ DON'T KNOW
999 ○ REFUSED

Next

Progress 70%

Q18D CASE ID: 0000000029 PIN:

And 7 subtracted from that?

888 ○ DON'T KNOW
999 ○ REFUSED

Next

Progress 72%

Q18E	CASE ID: 0000000029 PIN:
And 7 subtracted from that?	**888** ○ DON'T KNOW **999** ○ REFUSED

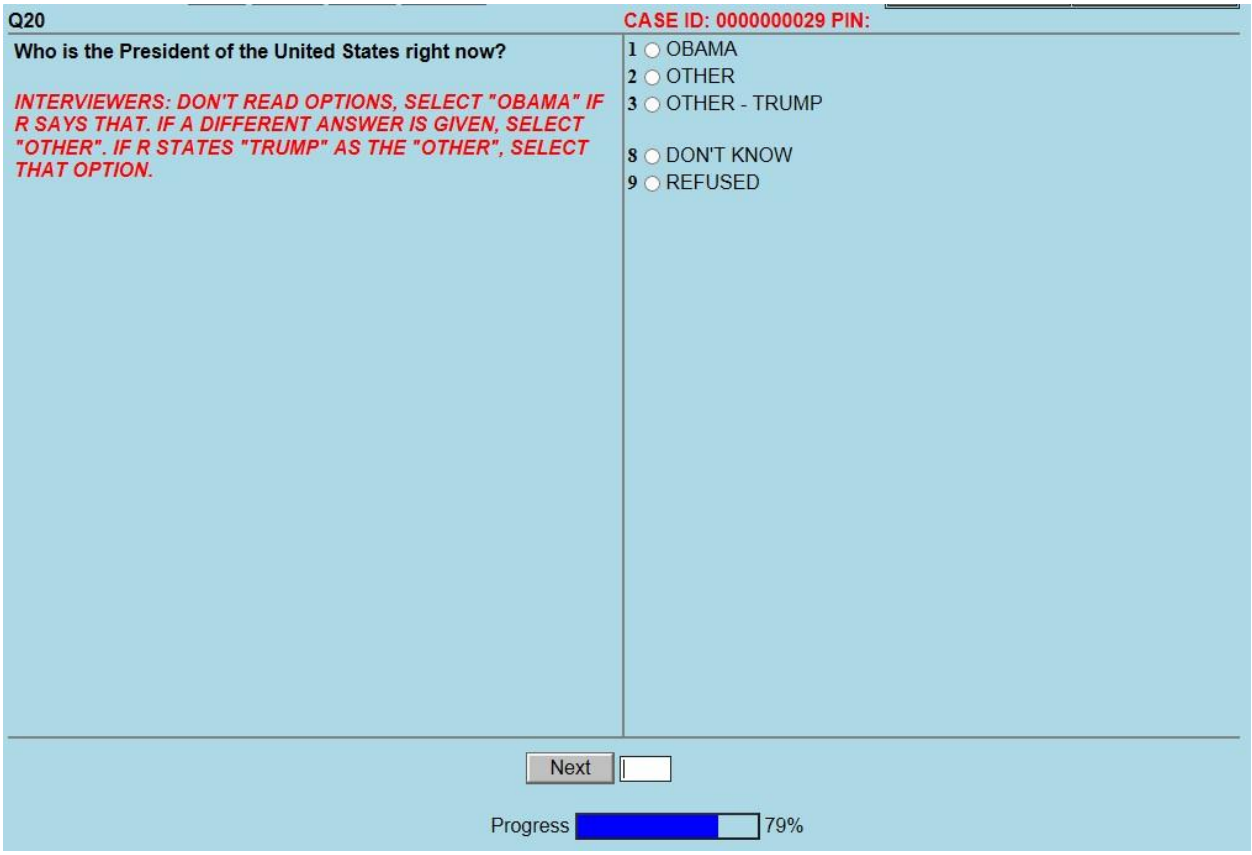
Next

Progress 74%

Q19	CASE ID: 0000000029 PIN:
Now I'm going to ask you for the names of some people and things. **What do people usually use to cut paper?** ***INTERVIEWERS: DON'T READ OPTIONS, SELECT "SCISSORS OR SHEARS" IF R SAYS ONE OF THOSE. IF A DIFFERENT ANSWER IS GIVEN, SELECT "OTHER".***	**1** ○ SCISSORS OR SHEARS **2** ○ OTHER **8** ○ DON'T KNOW **9** ○ REFUSED

Next

Progress 77%



Q20 CASE ID: 0000000029 PIN:

Who is the President of the United States right now?

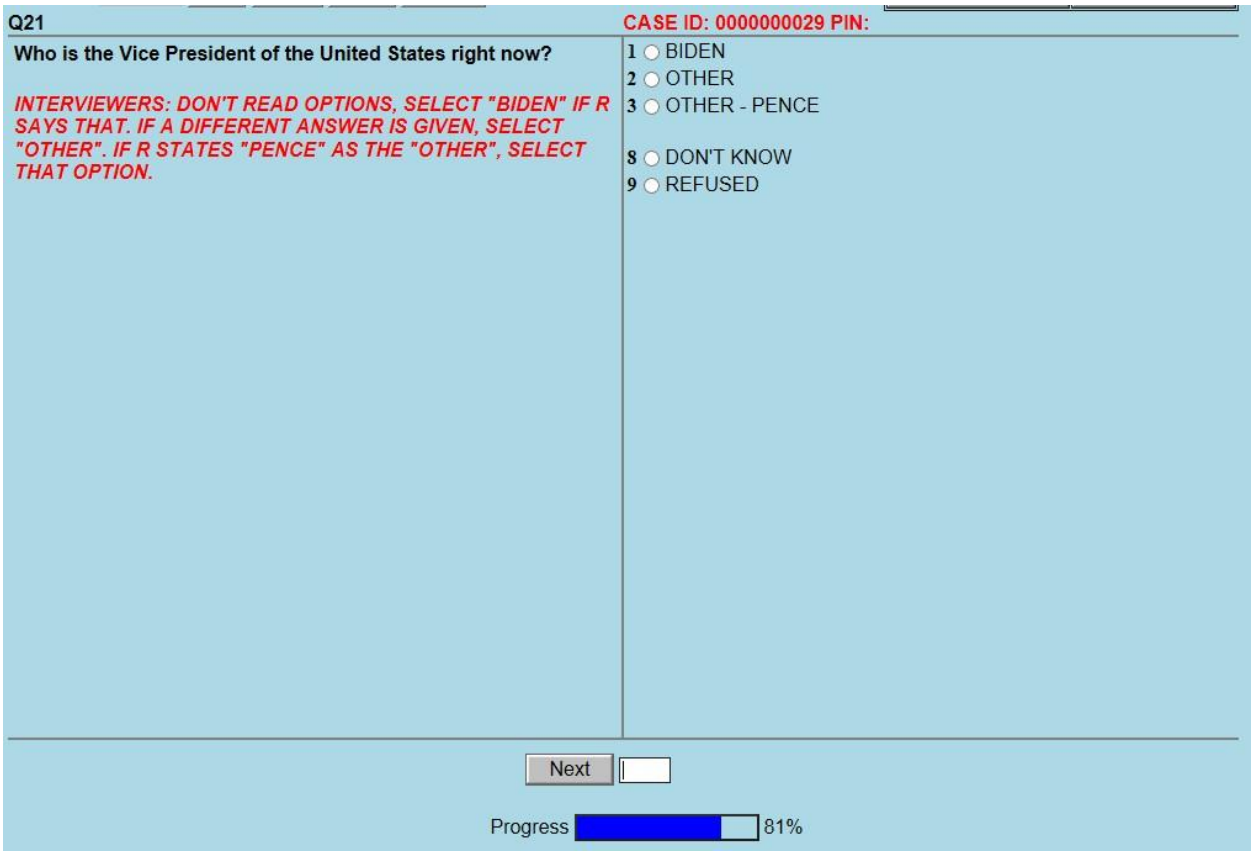
INTERVIEWERS: DON'T READ OPTIONS, SELECT "OBAMA" IF R SAYS THAT. IF A DIFFERENT ANSWER IS GIVEN, SELECT "OTHER". IF R STATES "TRUMP" AS THE "OTHER", SELECT THAT OPTION.

1 ○ OBAMA
2 ○ OTHER
3 ○ OTHER - TRUMP

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 79%



Q21 CASE ID: 0000000029 PIN:

Who is the Vice President of the United States right now?

INTERVIEWERS: DON'T READ OPTIONS, SELECT "BIDEN" IF R SAYS THAT. IF A DIFFERENT ANSWER IS GIVEN, SELECT "OTHER". IF R STATES "PENCE" AS THE "OTHER", SELECT THAT OPTION.

1 ○ BIDEN
2 ○ OTHER
3 ○ OTHER - PENCE

8 ○ DON'T KNOW
9 ○ REFUSED

Next

Progress 81%

Q22 CASE ID: 0000000029 PIN:

Now I will read a set of 10 words and ask you to recall as many as you can. We have purposely made the list long so that it will be difficult for anyone to recall all the words - most people only recall just a few. Please listen carefully as I read the set of words because I cannot repeat them. When I finish, I will ask you to recall aloud as many of the words as you can, in any order. Is this clear?

The words are…

Hotel
River
Tree
Skin
Gold
Market
Paper
Child
King, and
Book

INTERVIEWER: CHECK ALL THE WORDS THEY RECALL CORRECTLY. THEY ARE LISTED IN ALPHABETICAL ORDER FOR YOUR CONVENIENCE.

- 01 ☐ BOOK
- 02 ☐ CHILD
- 03 ☐ GOLD
- 04 ☐ HOTEL
- 05 ☐ KING
- 06 ☐ MARKET
- 07 ☐ PAPER
- 08 ☐ RIVER
- 09 ☐ SKIN
- 10 ☐ TREE

- 88 ☐ DON'T KNOW
- 99 ☐ REFUSED

Next

Progress 83%

Q23 CASE ID: 0000000029 PIN:

The following questions are for demographic purposes only.

What is your age?

- 888 ○ DON'T KNOW
- 999 ○ REFUSED

Next

Progress 85%

Q24	CASE ID: 0000000029 PIN:
What is your sex? *INTERVIEWER: DO NOT READ CHOICES*	1 ○ MALE 2 ○ FEMALE 3 ○ OTHER 8 ○ DON'T KNOW 9 ○ REFUSED

Next

Progress 87%

Q25	CASE ID: 0000000029 PIN:
What is your highest level of education? *INTERVIEWER: DO NOT READ CHOICES*	1 ○ LESS THAN HIGH SCHOOL GRADUATE 2 ○ HIGH SCHOOL GRADUATE 3 ○ SOME COLLEGE, BUT NO DEGREE 4 ○ TECHNICAL/TRADE/COMMUNITY COLLEGE/ASSOCIATE'S DEGREE 5 ○ BACHELOR'S DEGREE (4-YEAR, BS, BA, RN) 6 ○ POST GRADUATE DEGREE (MASTERS, PHD, LAW, MEDICINE) 8 ○ DON'T KNOW 9 ○ REFUSED

Next

Progress 89%

Q26	CASE ID: 0000000029 PIN:
Are you now employed full-time, part-time, not employed, retired, a student, or something else?	1 ○ EMPLOYED FULL-TIME 2 ○ EMPLOYED PART-TIME 3 ○ NOT EMPLOYED 4 ○ RETIRED 5 ○ STUDENT 6 ○ OTHER 8 ○ DON'T KNOW 9 ○ REFUSED

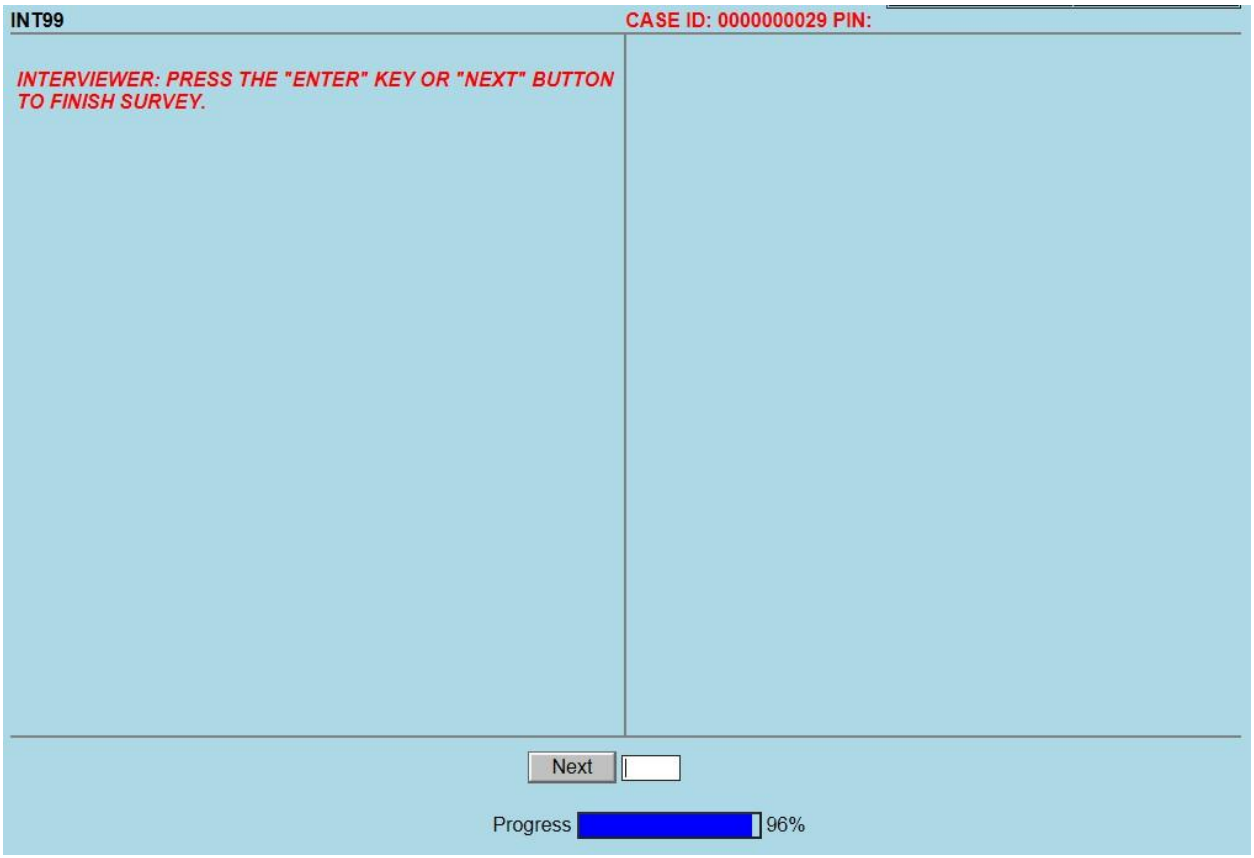
Next

Progress 91%

COMMENT	CASE ID: 0000000029 PIN:
That concludes our survey. I'd like to thank you for taking the time to help us with this important study. Do you have any questions or comments you would like us to know?	1 ◉ COMMENT 2 ○ NO COMMENT

Next

Progress 94%


INT99
CASE ID: 0000000029 PIN:
INTERVIEWER: PRESS THE "ENTER" KEY OR "NEXT" BUTTON TO FINISH SURVEY.
Next
Progress
96%

Appendix A3: Letters for Web Version

Initial Letter

BUREAU OF SOCIOLOGICAL RESEARCH

University of Nebraska Lincoln

DATE

Nebraska Resident
Address

Dear Nebraska Resident:

I am a student at the University of Nebraska—Lincoln (UNL) in the Survey Research and Methodology program working on the final requirement of my doctoral degree under the advisement of Dr. Robert Belli. I am writing today to ask for help from a member of your household with a study I am conducting to better understand how memory impacts survey responses. By participating in this survey, you will be helping me to complete my dissertation so that I can graduate in the coming year.

Please have any adult in the household **age 19 or older** complete the survey by going to the web address listed below and entering the access code: XXXXX

Insert web address here

This survey should only take about 15 minutes to complete. Your participation in this survey is completely voluntary, and all responses will be kept confidential. There are no risks to participating in this survey, and you can refuse to participate at any time without harming your relationship with the University of Nebraska-Lincoln. There are no direct benefits to participation. To protect your confidentiality, all of the data we compile will be presented in a summarized form so that no one person's answers can be identified. The data will be stored on an encrypted server that lives and is maintained by UNL.

The survey is being administered through the Bureau of Sociological Research (BOSR) at UNL. If you have any questions, please contact BOSR by telephone at 1-800-480-4549 or by e-mail at bosr@unl.edu. This voluntary survey has been reviewed and approved by the UNL Institutional Review Board (#20160716261 EX). They are happy to answer any questions you have about being a participant and can be reached at 402-472-6965.

Thank you for your help with this study and for helping me finish my degree.

Sincerely,

Beth Cochran
Graduate Student and Study Director
Survey Research and Methodology Program
University of Nebraska - Lincoln

Dr. Robert Belli
Professor and Ph.D. Advisor
Psychology
University of Nebraska - Lincoln

907 Oldfather Hall / P.O. Box 880325 / Lincoln, NE 68588-0325 / (402)472-3672 / 1-800-480-4549 / bosr@unl.edu

Follow-up Letter

BUREAU OF SOCIOLOGICAL RESEARCH

University of Nebraska Lincoln

DATE

Nebraska Resident
Address

Dear Nebraska Resident:

I am a student at the University of Nebraska—Lincoln (UNL) in the Survey Research and Methodology program working on the final requirement of my doctoral degree under the advisement of Dr. Robert Belli. A few weeks ago, your household was sent an invitation to participate in a study I am conducting to complete my dissertation.

I am writing again to ask for your help with this study. Your response is critically important to the quality of this research. Please have any adult in the household **age 19 or older** complete the survey by going to the web address listed below and entering the access code: XXXXX

Insert web address here

This survey should only take about 15 minutes to complete. Your participation in this survey is completely voluntary, and all responses will be kept confidential. There are no risks to participating in this survey, and you can refuse to participate at any time without harming your relationship with the University of Nebraska-Lincoln. There are no direct benefits to participation. To protect your confidentiality, all of the data we compile will be presented in a summarized form so that no one person's answers can be identified. The data will be stored on an encrypted server that lives and is maintained by UNL.

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Thank you for your help with this study and for helping me finish my degree.

Sincerely,

Beth Cochran
Graduate Student and Study Director
Survey Research and Methodology Program
University of Nebraska - Lincoln

Dr. Robert Belli
Professor and Ph.D. Advisor
Psychology
University of Nebraska - Lincoln

Appendix A4: Letters for Phone Version

Initial Letter

BUREAU OF SOCIOLOGICAL RESEARCH

University of Nebraska Lincoln

DATE

Nebraska Resident
Address

Dear Nebraska Resident:

I am a student at the University of Nebraska—Lincoln (UNL) in the Survey Research and Methodology program working on the final requirement of my doctoral degree under the advisement of Dr. Robert Belli. I am writing today to ask for help from a member of your household with a study I am conducting to better understand how memory impacts survey responses. By participating in this survey, you will be helping me to complete my dissertation so that I can finish my degree in the coming year.

For this study, I am asking you to participate in a short phone survey that will take about 15 minutes to complete. To participate, **please return the enclosed card** in the envelope provided with a phone number to best reach an **adult age 19 or older**.

Your phone number will be kept secure and will only be used for my study. You will be contacted by an interviewer at the Bureau of Sociological Research (BOSR) at UNL to complete the survey. Your participation in this survey is completely voluntary, and all responses will be kept confidential. There are no risks to participating in this survey, and you can refuse to participate at any time without harming your relationship with the University of Nebraska-Lincoln. There are no direct benefits to participation. To protect your confidentiality, all of the data we compile will be presented in a summarized form so that no one person's answers can be identified.

If you have any questions, please contact BOSR by telephone at 1-800-480-4549 or by e-mail at bosr@unl.edu. This voluntary survey has been reviewed and approved by the UNL Institutional Review Board (#XXXXXXX). They are happy to answer any questions you have about being a participant and can be reached at 402-472-6965.

Thank you for your help with this study and for helping me finish my degree.

Sincerely,

Beth Cochran
Graduate Student and Study Director
Survey Research and Methodology Program
University of Nebraska - Lincoln

Dr. Robert Belli
Professor and Ph.D. Advisor
Psychology
University of Nebraska - Lincoln

907 Oldfather Hall / P.O. Box 880325 / Lincoln, NE 68588-0325 / (402)472-3672 / 1-800-480-4549 / bosr@unl.edu

Follow-up Letter

BUREAU OF SOCIOLOGICAL RESEARCH

University of Nebraska Lincoln

DATE

Nebraska Resident
Address

Dear Nebraska Resident:

I am a student at the University of Nebraska—Lincoln (UNL) in the Survey Research and Methodology program working on the final requirement of my doctoral degree under the advisement of Dr. Robert Belli. A few weeks ago, your household was sent an invitation to participate in a study I am conducting to complete my dissertation.

I am writing again to ask for your help with this study. Your response is critically important to the quality of this research. For this study, I am asking you to participate in a short phone survey that will take about 15 minutes to complete. To participate, **please return the enclosed card** in the envelope provided with a phone number to best reach an **adult age 19 or older**.

Your phone number will be kept secure and will only be used for my study. You will be contacted by an interviewer at the Bureau of Sociological Research (BOSR) at UNL to complete the survey. Your participation in this survey is completely voluntary, and all responses will be kept confidential. There are no risks to participating in this survey, and you can refuse to participate at any time without harming your relationship with the University of Nebraska-Lincoln. There are no direct benefits to participation. To protect your confidentiality, all of the data we compile will be presented in a summarized form so that no one person's answers can be identified.

I am happy to answer any questions you may have about this survey. If you have any questions, please contact BOSR by telephone at 1-800-480-4549 or by e-mail at bosr@unl.edu. This voluntary survey has been reviewed and approved by the UNL Institutional Review Board (#20160716261 EX). They are happy to answer any questions you have about being a participant and can be reached at 402-472-6965.

Thank you for your help with this study and for helping me finish my degree.

Sincerely,

Beth Cochran
Graduate Student and Study Director
Survey Research and Methodology Program
University of Nebraska - Lincoln

Dr. Robert Belli
Professor and Ph.D. Advisor
Psychology
University of Nebraska - Lincoln

Appendix A5: Phone Number Request Card

Please provide the phone number, including area code, to best reach an adult in the household age 19 or older.

Phone number: (_____) _____-_____

When is the best time to reach you? Check all that apply.

☐ Mornings ☐ Weekdays
☐ Afternoons ☐ Weekends
☐ Evenings

Thank you for your willingness to participate in the survey to help me finish my degree.

Sincerely,

Beth Cochran
Graduate Student and Study Director
Survey Research and Methodology
University of Nebraska - Lincoln

Dr. Robert Belli
Professor and Ph.D. Advisor
Psychology
University of Nebraska - Lincoln

Appendix A6: Interviewer Study Guide

Interviewers were provided with a study guide to provide them with background information, instructions, and clarifications on the questionnaire.

Cochran Phone Survey

In Voxco:
Practice version – Beth Practice
Real version – Beth

This is a survey being conducted to help a Survey Research and Methodology PhD student (Beth Cochran) with her dissertation research. The survey is being conducted over the phone and on the web, but respondents will never move from one mode to the other. The survey is a little different from other phone surveys we normally conduct and mainly concerns memory.

The Population

The population for this survey came from two places: (1) individuals who filled out and returned a NASIS Future Research Card in the past three years, and (2) a random selection of households in Nebraska. Those who filled out the Future Research Card and provided a phone number, we will start calling right away. For those who didn't provide a phone number on the card and the second group, we mailed a letter explaining the study and a card to return so they can provide a phone number. We will process returned cards and a add numbers to Voxco as the come back in. Since respondent will have deliberately given their phone numbers to us, they should be more willing than normal to complete the survey and we should have fewer refusals and hang-ups.

The Interview

The interview must be completed by an adult in the household who is 19 years of age or older. The interview should usually take about 15 minutes to complete. As mentioned, this survey is a little different than other phone surveys we normally do and there are some quirks you should be aware of before you start calling. As always, you should be reading *all* response options that are not in all caps. Any response options in all caps should not be read but are there for you to use if you need them.

Questions 1-6

For these questions, the order of response options is random so they won't be same every time you read them to the respondent. Also, there are unstated response options you can use for when the respondent doesn't partake in a particular activity we are asking about (read, watch sporting events, etc.).

Questions 7 & 8, 9 & 10, and 11 & 12

These pairs of questions will come in a random order. For example, questions 7 and 8 ask about personal happiness and happiness with a relationship. Sometimes you will get the relationship question first. Sometimes you will get the personal happiness question first.

Memory Questions

Questions 13 through 22 deal with the respondents' memory. Each will have specific ways in how they are to be read to the respondent and how you will code the respondents' answers.

Questions 14 & 15

For these, you will ask the respondent a number of true/false statements and then ask the respondent to repeat the last word of each statement. Check off all the words the respondent got correct. If the respondent did not get any correct, select that option. Do not repeat the words or statements for the respondent.

Questions 16 & 17

For these, you will read a set of words one at a time in a specific order. Please read these slowly and deliberately. As you will instruct the respondent, you cannot repeat the words. You will then ask the respondent to report the words back to you in alphabetical order. When coding this, you will have a grid to report what was said first, second, third, etc. (see below). Each row must be filled out. Make sure you DO NOT use the same word on two rows (e.g. in the table below do not select the "FLAG" column for the "1ST" and "3RD" response).

	FLAG	HOME	WIFE	OTHER	DON'T KNOW	REFUSED
1ST:	○	○	○	○	○	○
2ND:	○	○	○	○	○	○
3RD:	○	○	○	○	○	○

Question 18

This question asks the respondent to start at 100 and subtract 7 from that number 5 times. Please do not help the respondent or remind them of the answer they gave on a previous screen.

Questions 19, 20, & 21

These questions are open-ended but we only care if they give a certain answer or not. It should be pretty clear with the instructions that are on the question. For 20 and 21 asking about the current president and vice president, respondents might be confused by the recent election even though Obama is still in office until January. If the respondent gives Trump or Pence as president and vice president respectively, select the "OTHER-TRUMP" or "OTHER-PENCE" option.

Question 22

Like questions 16 and 17, you will read a list of words. Again, please read these slowly and deliberately and do not repeat the words for the respondent. Simply check off any and all of the words the respondent repeats back.

Letters

Here are copies of the letters sent to respondents to ask for phone numbers for your reference:

First Letter

BUREAU OF SOCIOLOGICAL RESEARCH

University of Nebraska Lincoln

November 4, 2016

Nebraska Resident
«addr1» «addr2»
«city», «st» «zip»-«zip4»

Dear Nebraska Resident:

I am a student at the University of Nebraska—Lincoln (UNL) in the Survey Research and Methodology program working on the final requirement of my doctoral degree under the advisement of Dr. Robert Belli. I am writing today to ask for help from a member of your household with a study I am conducting to better understand how memory impacts survey responses. By participating in this survey, you will be helping me to complete my dissertation so that I can finish my degree in the coming year.

For this study, I am asking you to participate in a short phone survey that will take about 15 minutes to complete. To participate, **please return the enclosed card** in the envelope provided with a phone number to best reach an **adult age 19 or older**.

Your phone number will be kept secure and will only be used for my study. You will be contacted by an interviewer at the Bureau of Sociological Research (BOSR) at UNL to complete the survey. Your participation in this survey is completely voluntary, and all responses will be kept confidential. There are no risks to participating in this survey, and you can refuse to participate at any time without harming your relationship with the University of Nebraska-Lincoln. There are no direct benefits to participation. To protect your confidentiality, all of the data we compile will be presented in a summarized form so that no one person's answers can be identified.

If you have any questions, please contact BOSR by telephone at 1-800-480-4549 or by e-mail at bosr@unl.edu. This voluntary survey has been reviewed and approved by the UNL Institutional Review Board (#20160716261 EX). They are happy to answer any questions you have about being a participant and can be reached at 402-472-6965.

Thank you for your help with this study and for helping me finish my degree.

Sincerely,

Beth Cochran
Graduate Student and Study Director
Survey Research and Methodology Program
University of Nebraska - Lincoln

Dr. Robert Belli
Professor and Ph.D. Advisor
Psychology
University of Nebraska - Lincoln

907 Oldfather Hall / P.O. Box 880325 / Lincoln, NE 68588-0325 / (402)472-3672 / 1-800-480-4549 / bosr@unl.edu

Second Letter

BUREAU OF SOCIOLOGICAL RESEARCH

University of Nebraska Lincoln

November 18, 2016

Nebraska Resident
Address

Dear Nebraska Resident:

I am a student at the University of Nebraska—Lincoln (UNL) in the Survey Research and Methodology program working on the final requirement of my doctoral degree under the advisement of Dr. Robert Belli. A few weeks ago, your household was sent an invitation to participate in a study I am conducting to complete my dissertation.

I am writing again to ask for your help with this study. Your response is critically important to the quality of this research. For this study, I am asking you to participate in a short phone survey that will take about 15 minutes to complete. To participate, **please return the enclosed card** in the envelope provided with a phone number to best reach an **adult age 19 or older**.

Your phone number will be kept secure and will only be used for my study. You will be contacted by an interviewer at the Bureau of Sociological Research (BOSR) at UNL to complete the survey. Your participation in this survey is completely voluntary, and all responses will be kept confidential. There are no risks to participating in this survey, and you can refuse to participate at any time without harming your relationship with the University of Nebraska-Lincoln. There are no direct benefits to participation. To protect your confidentiality, all of the data we compile will be presented in a summarized form so that no one person's answers can be identified.

I am happy to answer any questions you may have about this survey. If you have any questions, please contact BOSR by telephone at 1-800-480-4549 or by e-mail at bosr@unl.edu. This voluntary survey has been reviewed and approved by the UNL Institutional Review Board (#20160716261 EX). They are happy to answer any questions you have about being a participant and can be reached at 402-472-6965.

Thank you for your help with this study and for helping me finish my degree.

Sincerely,

Beth Cochran
Graduate Student and Study Director
Survey Research and Methodology Program
University of Nebraska - Lincoln

Dr. Robert Belli
Professor and Ph.D. Advisor
Psychology
University of Nebraska - Lincoln

907 Oldfather Hall / P.O. Box 880325 / Lincoln, NE 68588-0325 / (402)472-3672 / 1-800-480-4549 / bosr@unl.edu

«Random ID»

Phone Number Request Card

Please provide the phone number, including area code, to best reach an adult in the household age 19 or older.

Phone number: (_____)_____-_____

When is the best time to reach you? Check all that apply.

- ☐ Mornings
- ☐ Afternoons
- ☐ Evenings
- ☐ Weekdays
- ☐ Weekends

Thank you for your willingness to participate in the survey to help me finish my degree.

Sincerely,

Beth Cochran
Graduate Student and Study Director
Survey Research and Methodology
University of Nebraska - Lincoln

Dr. Robert Belli
Professor and Ph.D. Advisor
Psychology
University of Nebraska - Lincoln

Appendix A7: Questionnaire Version Differences

Questions 1 through 3 varied the order of response options. Odd versions (1, 3, and 5) had one direction while even versions (2, 4, and 6) had the other.

		Question Number		
		1	2	3
Version	1	Fiction Non-fiction	Action Drama	Broadway Musical Classical Ballet
	2	Non-fiction Fiction	Drama Action	Classical Ballet Broadway Musical
	3	Fiction Non-fiction	Action Drama	Broadway Musical Classical Ballet
	4	Non-fiction Fiction	Drama Action	Classical Ballet Broadway Musical
	5	Fiction Non-fiction	Action Drama	Broadway Musical Classical Ballet
	6	Non-fiction Fiction	Drama Action	Classical Ballet Broadway Musical

For questions 4 through 6, response options presented in different order for each version.

		Question Number		
		4	5	6
Version	1	Rock	Basketball	Art Museum
		Country	Soccer	Amusement Park
		Pop	Baseball	Historical Monument
		Rap	Hockey	State Capitol Building
		R&B	Golf	Science Museum
		Gospel	Volleyball	National Park
	2	Country	Soccer	Amusement Park
		Pop	Baseball	Historical Monument
		Rap	Hockey	State Capitol Building
		R&B	Golf	Science Museum
		Gospel	Volleyball	National Park
		Rock	Basketball	Art Museum
	3	Rock	Volleyball	National Park
		Country	Basketball	Art Museum
		Pop	Soccer	Amusement Park
		Rap	Baseball	Historical Monument
		R&B	Hockey	State Capitol Building
		Gospel	Golf	Science Museum
	4	Pop	Baseball	Historical Monument
		Rap	Hockey	State Capitol Building
		R&B	Golf	Science Museum
		Gospel	Volleyball	National Park
		Rock	Basketball	Art Museum
		Country	Soccer	Amusement Park
	5	R&B	Golf	Science Museum
		Gospel	Volleyball	National Park
		Rock	Basketball	Art Museum
		Country	Soccer	Amusement Park
		Pop	Baseball	Historical Monument
		Rap	Hockey	State Capitol Building
	6	Rap	Hockey	State Capitol Building
		R&B	Golf	Science Museum
		Gospel	Volleyball	National Park
		Rock	Basketball	Art Museum
		Country	Soccer	Amusement Park
		Pop	Baseball	Historical Monument

Questions 7 through 12 were had question orders of each pair (7 & 8, 9 & 10, and 11 & 12) alternated between even and odd versions.

		Question Number		
		7 & 8	9 & 10	11 & 12
Version	1	How would you say things are…	Do you believe workers and unions have the right to strike…	…obtain a legal abortion if she is married and does not want any more children?
		How would you describe your relationship…	Do you believe that businessmen have a right to shut down…	…obtain a legal abortion if there is a strong chance of serious defect in the baby?
	2	How would you describe your relationship…	Do you believe that businessmen have a right to shut down…	…obtain a legal abortion if there is a strong chance of serious defect in the baby?
		How would you say things are…	Do you believe workers and unions have the right to strike…	…obtain a legal abortion if she is married and does not want any more children?
	3	How would you say things are…	Do you believe workers and unions have the right to strike…	…obtain a legal abortion if she is married and does not want any more children?
		How would you describe your relationship…	Do you believe that businessmen have a right to shut down…	…obtain a legal abortion if there is a strong chance of serious defect in the baby?
	4	How would you describe your relationship…	Do you believe that businessmen have a right to shut down…	…obtain a legal abortion if there is a strong chance of serious defect in the baby?
		How would you say things are…	Do you believe workers and unions have the right to strike…	…obtain a legal abortion if she is married and does not want any more children?
	5	How would you say things are…	Do you believe workers and unions have the right to strike…	…obtain a legal abortion if she is married and does not want any more children?
		How would you describe your relationship…	Do you believe that businessmen have a right to shut down…	…obtain a legal abortion if there is a strong chance of serious defect in the baby?
	6	How would you describe your relationship…	Do you believe that businessmen have a right to shut down…	…obtain a legal abortion if there is a strong chance of serious defect in the baby?
		How would you say things are…	Do you believe workers and unions have the right to strike…	…obtain a legal abortion if she is married and does not want any more children?

Appendix A8: AAPOR Transparency Initiative Immediate Disclosure Items

1. Who sponsored the research study
   Overview
2. Who conducted the research study
   Overview
3. If who conducted the study is different from the sponsor, the original sources of funding will also be disclosed.
   Overview
4. The exact wording and presentation of questions and response options whose results are reported. This includes preceding interviewer or respondent instructions and any preceding questions that might reasonably be expected to influence responses to the reported results.
   Appendix A, Appendix B, Appendix F, Appendix G
5. A definition of the population under study and its geographic location.
   Sample
6. Dates of data collection.
   Data Collection
7. A description of the sampling frame(s) and its coverage of the target population, including mention of any segment of the target population that is not covered by the design. This many include, for example, exclusion of Alaska and Hawaii in U.S. surveys; exclusion of specific provinces or rural areas in international surveys; and exclusion of non-panel members in panel surveys. If possible the estimated size of non-covered segments will be provided. If a size estimate cannot be provided, this will be explained. If no frame or list was utilized, this will be indicated.
   Sample
8. The name of the sample supplier, if the sampling frame and/or the sample itself was provided by a third party.
   Sample
9. The methods used to recruit the panel or participants, if the sample was drawn from a pre-recruited panel or pool of respondents.
   Sample
10. A description of the sample design, giving a clear indication of the method by which the respondents were selected, recruited, intercepted or otherwise contacted or encountered, along with any eligibility requirements and/or oversampling. If quotas were used, the variables defining the quotas will be reported. If a within-household selection procedure was used, this will be described. The description of the sampling frame and sample design will include sufficient detail to determine whether the respondents were selected using probability or non-probability methods.

Sample, Data Collection

11. Method(s) and mode(s) used to administer the survey (e.g., CATI, CAPI, ACASI, IVR, mail survey, web survey) and the language(s) offered.

Data Collection

12. Sample sizes (by sampling frame if more than on was used) and a discussion of the precision of the findings. For probability samples, the estimates of sampling error will be reported, and the discussion will state whether or not the reported margins of sampling error or statistical analyses have been adjusted for the design effect due to weighting, clustering, or other factors. Disclosure requirements for non-probability samples are different because the precision of estimates from such samples is a model-based measure (rather than the average deviation from the population value over all possible samples). Reports of non-probability samples will only provide measures of precision if they are accompanied by a detailed description of how the underlying model was specified, its assumptions validated and the measure(s) calculated. To avoid confusion, it is best to avoid using the term "margin of error" or "margin of sampling error" in conjunction with non-probability samples.

13. A description of how the weights were calculated, including the variables used and the sources of weighting parameters, if weighted estimates are reported.

N/A

14. If the results reported are based on multiple samples or multiple modes, the preceding items will be disclosed for each.

N/A

15. Contact for obtaining more information about the study.

Summary

APPENDIX B: OPEN-ENDED WEB QUESTIONS – ACCEPTED MISSPELLINGS

For the web administered survey, respondents were responsible for typing their answers to the memory questions. As a result of words being easily misspelled either due to typing errors or unknown correct spellings, each open-ended question was reviewed for correct answers that may have been misspelled. Words were considered correct if there were only minor misspellings (e.g., leaving off/adding an "s", inverted letters, etc.) or if the word was spelled phonetically correct (e.g., sysers for scissors). Potential misspellings that created a different word than the one that should have been recalled were not accepted. For example, "brains" and "bars" were not accepted when the anticipated words were "trains" and "cars". All accepted misspellings are listed in the tables below with the first row showing the anticipated words.

Question 14:

Blue
Blu

Question 15:

Land	**Trains**	**Sweet**	**Chair**	**Cars**
Lands	Train	Sweets	Chairs	Car
			Cahir	

Question 16:

Flag	**Wife**
Fiag	Wif
Fkag	Wfe
Flad	

Question 17:

Blood	**Earth**	**Girl**	**Shoes**
Blod	Enarth	Girls	Shoe
Bloody	Eart		

Question 19:

Scissor(s)	
Sizzors	Scissoirs
Scizzors	Scisssor
Sissor	Siccors
Sissors	Sicissors
Sysers	Siscors
Sccisors	Sizzers
Scisors	

Question 20:

Due to the survey being administered soon after the 2016 Presidential election, Trump was also accepted. There were no misspellings of Trump.

Obama
Obma
Oboma
O bama
Obomma

Question 21: Due to the survey being administered soon after the 2016 Presidential election, Pence was also accepted. There were no misspellings of Pence.

Biden
Bidan
Blden
Bidden
Bidon
Bidin
Bidden

Question 22:

Child	**Gold**	**Hotel**	**River**	**Skin**	**Tree**
Chlid	Golden	Hotal	R,iver	Scin	Trees